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THE Presidential Address of this year at Aberdeen, powerful and thorough as it is, has no special reference whatever to the matters to which our columns are devoted, but it appeals generally to workers in all branches of science. Without giving the speech of the Right Hon. Sir Lyon Playfair in full, we publish in his own language the main features upon which he touched. Last year's visit to Canada formed the subject of his opening remarks, which were as follows :—

Our last meeting at Montreal was a notable event in the life of the British Association, and even marked a distinct epoch in the history of civilisation. It was by no mere accident that the constitution of the Association enabled it to embrace all parts of the British Empire. Science is truly catholic, and is bounded only by the universe. No part of the British Empire was more suited than Canada to try whether her science could be federated with our science. The Dominion still requires consolidation in its vast extent, and applied science is rapidly effecting it. Canada, with its great expanse of territory, nearly as large as the United States, is being knit together by the iron bands of railways from the Gulf of St. Lawrence to the Pacific Ocean, so that the fertile lands of Ontario, Manitoba, Columbia, and the North-Western territories will soon be available to the world.

With a far-reaching foresight the Canadian Government invited the British Association for the Advancement of Science to meet in Montreal. The inhabitants of Canada received us with open arms, and the science of the Dominion and that of the United Kingdom were welded. Our great men are their great men; our Shakspeare, Milton, and Burns belong to them as much as to ourselves; our Newton, Dalton, Faraday, and Darwin are their men of science as much as they are ours. Nothing can be more cheering to our Association than to know that many of the young communities of English-speaking people all over the globe—in India, China, Japan, the Straits, Ceylon, Australia, New Zealand, the Cape—have founded scientific societies in order to promote the growth of scientific research. No doubt science, which is only a form of truth, is one in all lands, but still its unity of purpose and fulfilment received an important practical expression by our visit to Canada. This community of science will be continued by the fact that we have invited Sir William Dawson, of Montreal, to be our next President at Birmingham.

Science and the State.—The importance of promoting science as a duty of statecraft was well enough known to the ancients, especially to the Greeks and Arabs, but it ceased to be recognised in the dark ages, and was lost to sight during the revival of letters in the fifteenth and sixteenth centuries. Germany and France, which are now in such active competition in promoting science, have only publicly acknowledged its national importance in recent times. More remarkable is it to see a young nation like the United States reserving 150,000,000 acres of national lands for the promotion of scientific education. In some respects this young country is in advance of all European nations in joining science to its administrative offices. Its scientific publications, like the great palæontological work embodying the researches of Prof. Marsh and his associates in the Geological Survey, are an example to other Governments.

In the United Kingdom we are just beginning to understand the wisdom of Washington's farewell address to his countrymen, when he said :—"Promote as an object of primary importance institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened." It was only in 1870 that our Parliament established a system of national primary education. Secondary education is chaotic, and remains unconnected with the State, while the higher education of the universities is only brought at distant intervals under the view of the State. All great countries except England have ministers of education, but this country has only ministers who are the managers of primary schools. We are inferior even to smaller countries in the absence of organised State supervision of education. Greece, Portugal, Egypt, and Japan have distinct ministers of education, and so also among our colonies have Victoria and New Zealand. Gradually England is gathering materials for the establishment of an efficient education minister. The Department of Science and Art is doing excellent work in diffusing a taste for elementary science among the working classes. There are now about 78,000 persons who annually come under the influence of its science classes, while a small number of about 200, many of them teachers, receive thorough instruction in science at the excellent school in South Kensington of which Prof. Huxley is the dean. I do not dwell on the work of this Government department, because my object is chiefly to point out how it is that science lags in its progress in the United Kingdom owing to the deficient interest taken in it by the middle and upper classes. The working classes are being roused from their indifference. They show this by their selection of scientific men as candidates at the next election. Among these are Profs. Stuart, Roscoe, Maskelyne, and Rücker. It has its significance that such a humble representative of science as myself received invitations from working-class constituences in more than a dozen of the leading manufacturing towns. In the next Parliament I do not doubt that a minister of education will be created as a nucleus round which the various educational materials may crystallise in a definite form.

Science and Secondary Education.—Various royal commissions have made inquiries and issued recommendations in regard to our public and endowed schools. The Technical Commission which reported last year can only point to three schools in Great Britain in which science is fully and adequately taught. While the commission gives us the consolation that England is still in advance as an industrial nation, it warns us that foreign nations, which were not long ago far behind, are now making more rapid progress than this country, and will soon pass it in the race of competition unless we give increased attention to science in public education. A few of the large towns, notably Manchester, Bradford, Huddersfield, and Birmingham, are doing so. The working classes are now receiving better instruction in science than the middle classes. The competition of actual life asserts its own conditions, for the children of the latter find increasing difficulty in obtaining employment. The cause of this lies in the fact that the schools for the middle classes have not yet adapted themselves to the needs of modern life. A return just issued, on the motion of Sir John Lubbock, shows a lamentable deficiency in science teaching in a great proportion of the endowed schools. While 12 to 16 hours per week are devoted to classics, two to three hours are considered ample for science in a large proportion of the schools. In Scotland there are only six schools in the return which give more than two hours to science weekly, while in many schools its teaching is wholly omitted. Every other part of the kingdom stands in a better position than Scotland in relation to the science of its endowed schools.

As there is no use clamouring for an instrument of more compass and power until we have made up our mind as to the tune, Prof. Huxley, in his evidence before a Parliamentary Committee in 1884, has given a time table for grammar schools. He demands that out of their 40 hours for public and private study, 10 should be given to modern languages and history, eight to arithmetic and mathematics, six to science, and two to geography, thus leaving 14 hours to the dead languages. No time table would, however, be suitable to all schools. The great public schools of England will continue to be the gymnasia for the upper classes, and should devote much of their time to classical and literary culture. Even now they introduce into their curriculum subjects unknown to them when the Royal Commission of 1868 reported, though they still accept science with timidity. Unfortunately, the other grammar schools which educate the middle classes look to the higher public schools as a type to which they should conform, although their functions are so different. It is in the interest of the higher public schools that this difference should be recognised, so that, while they give an all-round education and expand their curriculum by a freer recognition of the value of science as an educational power in developing the faculties of the upper classes, the schools for the middle classes should adapt themselves to the needs of their existence, and not keep up a slavish imitation of schools with a different function.

In the school a boy should be aided to discover the class of knowledge that is best suited for his mental capacities, so that, in the upper forms of the school and in the university, knowledge may be specialised in order to cultivate the powers of the man to their fullest extent.

Passing from learned or public professions to commerce, how is it that in our great commercial centres, foreigners—German, Swiss, Dutch, and even Greeks—push aside our English youth and take the places of profit which belong to them by national inheritance? How is it that in our colonies, like those in South Africa, German enterprise is pushing aside English incapacity? How is it that we find whole branches of manufactures, when they depend on scientific knowledge, passing away from this country, in which they originated, in order to engraft themselves abroad, although their decaying roots remain at home? The answer to these questions is that our systems of education are still too narrow for the increasing struggle of life.

The opponents of science education allege that it is not adapted for mental development, because scientific facts are often disjointed and exercise only the memory. Those who argue thus do not know what science is. It is true that as science teaching has had less lengthened experience than that of literature, its methods of instruction are not so matured. Scientific and literary teaching have different methods; for while the teacher of literature rests on authority and on books for his guidance, the teacher of science discards authority and depends on facts at first hand, and on the book of Nature for their interpretation. Natural science more and more resolves itself into the teaching of the laboratory. In this way it can be used as a powerful means of quickening observation, and of creating a faculty of induction after the manner of Zadig, the Babylonian described by Voltaire. Thus facts become

surrounded by scientific conceptions, and are subordinated to order and law.

Science and the Universities.—The State has always felt bound to alter and improve universities, even when their endowments are so large as to render it unnecessary to support them by public funds. When universities are poor, Parliament gives aid to them from imperial taxation. In this country that aid has been given with a very sparing hand. Thus the universities and colleges of Ireland have received about £30,000 annually, and the same sum has been granted to the four universities of Scotland. Compared with imperial aid to foreign universities such sums are small. A single German university like Strasburg or Leipsic receives above £40,000 annually, or £10,000 more than the whole colleges of Ireland or of Scotland. Strasburg, for instance, has had her university and its library rebuilt at a cost of £711,000 and receives an annual subscription of £43,000. In rebuilding the university of Strasburg eight laboratories have been provided, so as to equip it fully with the modern requirements for teaching and research.* Prussia, the most economical nation in the world, spends £391,000 yearly out of taxation on her universities.

The recent action of France is still more remarkable. After the Franco-German War the Institute of France discussed the important question:—"Pourquoi la France n'a pas trouvé d'hommes supérieurs au moment du péril?" Startled by the intellectual sterility shown in the war, France has made gigantic efforts to retrieve her position, and has rebuilt the provincial colleges at a cost of £3,280,000, while her annual budget for their support now reaches half-a-million of pounds. In order to open these provincial colleges to the best talent of France, more than 500 scholarships have been founded at an annual cost of £30,000. France now recognises that it is not by the number of men under arms that she can compete with her great neighbour Germany, so she has determined to equal her in intellect. You will understand why it is that Germany was obliged, even if she had not been willing, to spend such large sums in order to equip the university of her conquered province, Alsace-Lorraine. France and Germany are fully aware that science is the source of wealth and power, and that the only way of advancing it is to encourage universities to make researches and to spread existing knowledge through the community. Other European nations are advancing on the same lines. Switzerland is a remarkable illustration of how a country can compensate itself for its natural disadvantages by a scientific education of its people. Switzerland contains neither coal nor the ordinary raw materials of industry, and is separated from other countries which might supply them by mountain barriers. Yet, by a singularly good system of graded schools, and by the great technical college of Zurich, she has become a prosperous manufacturing country. In Great Britain we have nothing comparable to this technical college, either in magnitude or efficiency. Belgium is reorganising its universities, and the State has freed the localities from the charge of buildings, and will in future equip the universities with efficient teaching resources out of public taxation. Holland, with a population of 4,000,000 and a small revenue of £9,000,000, spends £136,000 on her four universities. Contrast this liberality of foreign countries in the promotion of higher instruction with the action of our own country. Scotland, like Holland, has four universities, and is not very different from it in population, but it only receives £30,000 from the State. By a special clause in the Scotch Universities Bill the Government asked Parliament to declare that under no circumstances should the Parliamentary grant be ever increased above £40,000. According to the views of the British Treasury there is a finality in science and in expanding knowledge.

The wealthy universities of Oxford and Cambridge are gradually constructing laboratories for science. The merchant princes of Manchester have equipped their new Victoria University with similar laboratories. Edinburgh and Glasgow Universities have also done so, partly at the cost of Government and largely by private subscriptions. The poorer universities of Aberdeen and St. Andrews are still inefficiently provided with the modern appliances for teaching science.

London has one small Government college and two chartered colleges, but is wholly destitute of a teaching university. It would excite great astonishment at the Treasury if we were to make the modest request that the great metropolis, with a population of four millions, should be put into as efficient academical position as the town of Strasburg, with 104,000 inhabitants, by receiving, as that town does, £43,000 annually for academic instruction, and £700,000 for university buildings. Still, the amazing anomaly that London has no teaching university must ere long cease.

It is a comforting fact that, in spite of the indifference of Parliament, the large towns of the kingdom are showing their sense of the need of higher education. Manchester has already its university. Nottingham, Birmingham, Leeds and Bristol have colleges more or less complete. Liverpool converts a disused lunatic asylum into a college for sane people. Cardiff rents an infirmary for a collegiate building. Dundee, by private benefaction, rears a Baxter college with larger ambitions. All these are healthy signs that the public are determined to have advanced science teaching, but the resources of the institutions are altogether inadequate to the end in view. Even in the few cases where the laboratories are efficient for teaching purposes, they are inefficient as laboratories for research. Under these circumstances the Royal Commission on Science advocates special Government laboratories for research. Such laboratories, supported by public money, are as legitimate subjects for expenditure as galleries for pictures or sculpture; but I think that they would not be successful, and would injure science if they failed. It would be safer in the meantime if the State assisted universities or well-established colleges to found laboratories of research under their own care. Even such a proposal shocks our Chancellor of the Exchequer, who tells us that this country is burdened with public debt, and has ironclads to build and arsenals to provide. Nevertheless our wealth is proportionally much greater than that of foreign States which are competing with so much vigour in the promotion of higher education. They deem such expenditure to be true economy, and do not allow their huge standing armies to be an apology for keeping their people backwards in the march of knowledge. France, which in the last ten years has been spending a million annually on university education, had a war indemnity to pay, and competes successfully with this country in ironclads. Either all foreign States are strangely deceived in their belief that the competition of the world has become a competition of intellect, or we are marvellously unobservant of the change which is passing over Europe in the higher education of the people.

Universities are not mere storehouses of knowledge; they are also conservatories for its cultivation. The widening of the bounds of knowledge, literary or scientific, is the crowning glory of university life. Germany unites the functions of teaching and research in the universities, while France keeps them in separate institutions. The former system is best adapted to our habits, but its condition for success is that our science chairs should be greatly increased so that teachers should not be wholly absorbed in the duties of instruction. Germany subdivides the sciences into various chairs, and gives to the professors special laboratories. It also makes it a condition for the higher honours of a university that the candidates shall give proofs of their ability to make original researches. Under such a system, teaching and investigation are not incompatible. In the evidence before the Science Commission many opinions were given that scientific men engaged in research should not be burdened with the duties of education, and there is much to be said in support of this view when a single professor for the whole range of a physical science is its only representative in a university. But I hope that such a system will not long continue, for if it does we must occupy a very inferior position as a nation in the intellectual competition of Europe. Research and education in limited branches of higher knowledge are not incompatible. It is true that Galileo complained of the burden imposed upon him by his numerous astronomical pupils, though few other philosophers have echoed this complaint. Newton, who produced order in worlds, and Dalton, who brought atoms under the reign of order and number, rejoiced in their pupils. Lalande spread astronomers as Liebig spread chemists, and Johannes Müller biologists, all over the world. Laplace, La Grange, Dulong, Gay Lussac, Berthollet, and Dumas were professors as well as discoverers in France. In England our discoverers have generally been teachers. In fact, I recollect only three notable examples of men who were not—Boyle, Cavendish, and Joule. It was so in ancient as well as in modern times, for Plato and Aristotle taught and philosophised. If you do not make the investigator a schoolmaster, as Dalton was, and as practically our professors are at the present time, with the duty of teaching all branches of their sciences, the mere elementary truths as well as the highest generalisations being compressed into a course, it is well that they should be brought into contact with the world in which they live, so as to know its wants and aspirations. They could then quicken the pregnant minds around them, and extend to others their own power and love of research.

Our universities are still far from the attainment of a proper combination of their resources between teaching and research, Even Oxford and Cambridge, which have done so much in recent years in the equipment of laboratories and in adding to their scientific staff, are still far behind a second-class German university. The professional faculties of the English universities are growing, and will diffuse a greater taste for science among their students, though they may absorb the time of the limited professoriate so as to prevent it advancing the boundaries of knowledge. Professional faculties are absolutely essential to the existence of universities in poor countries like Scotland and Ireland. This has been the case from the early days of the Bologna University up to the present time. Originally universities arose not by mere bulls of popes, but as a response to the strong desire of the professional classes to dignify their crafts by real knowledge. If their education had been limited to mere technical schools like the Medical School of Salerno which flourished in the eleventh century, length but not breadth would have been given to education. So the universities wisely joined culture to the professional sciences. Poor countries like Scotland and Ireland must have their academic systems based on the professional faculties, although wealthy universities like Oxford and Cambridge may continue to have them as mere supplements to a more general education. A greater liberality of support on the part of the State in the establishment of chairs of science, for the sake of science and not merely for the teaching of the professions, would enable the poorer universities to take their part in the advancement of knowledge.

I have already alluded to the foundation of new colleges in different parts of the kingdom. Owens College has worthily

* The cost of these laboratories has been has follows:—Chemical Institute, £35,000; Physical Institute, £28,000; Botanical Institute, £26,000; Observatory, £25,000; Anatomy, £42,000; Clinical Surgery, £26,000; Physiological Chemistry, £16,000; Physiological Institute, £13,900.

developed into the Victoria University. Formerly she depended for degrees on the University of London. The other colleges which have formed themselves in large manufacturing districts are remarkable expressions from them that science must be promoted. Including the colleges of a high class, such as University College and King's College in London, and the three Queen's Colleges in Ireland, the aggregate attendance of students in colleges without university rank is between nine and ten thousand, while that of the universities is fifteen thousand. No doubt some of the provincial colleges require considerable improvement in their teaching methods; sometimes they unwisely aim at a full university curriculum when it would be better for them to act as faculties. Still they are all growing in the spirit of self-help, and some of them are destined, like Owens College, to develop into universities. This is not a subject of alarm to lovers of education, while it is one of hope and encouragement to the great centres of industry. There are too few autonomous universities in England in proportion to its population. While Scotland, with a population of 3¾ millions, has four universities with 6,500 students, England, with 26 millions of people, has only the same number of teaching universities with 6,000 students. Unless English colleges have such ambition, they may be turned into mere mills to grind out material for examinations and competitions. Higher colleges should always hold before their students that knowledge, for its own sake, is the only object worthy of reverence. Beyond college life there is a land of research flowing with milk and honey for those who know how to cultivate it. Colleges should at least show a Pisgah view of this Land of Promise, which stretches far beyond the Jordan of examinations and competitions.

Science and Industry.—The rapid development of industry in modern days depends on the applications of scientific knowledge, while its slower growth in former times was due to experiments being made by trial and error in order to gratify the needs of man. Much real science had at one time accumulated in Egypt, Greece, Rome, and Arabia, though it became obscured by the intellectual darkness which spread over Europe like a pall for many centuries. The mental results of Greek science, filtered through the Romans and Arabians, gradually fertilised the soil of Europe. Even in ages which are deemed to be dark and unprolific, substantial though slow progress was made. By the end of the fifteenth century the mathematics of the Alexandrian school had become the possession of Western Europe; Arabic numerals, algebra, trigonometry, decimal reckoning, and an improved calendar having been added to its stock of knowledge. The old discoveries of Democritus and Archimedes in physics, and of Hipparchus and Ptolemy in astronomy, were producing their natural developments, though with great slowness. Many manufactures, growing chiefly by experience, and occasionally lightened up by glimmerings of science throughout the prevailing darkness, had arisen before the sixteenth century. A knowledge of the properties of bodies, though scarcely of their relations to each other, came through the labours of the alchemists, who had a mighty impulse to work, for by the philosopher's stone, often not larger than half a rape-seed, they hoped to attain the three sensuous conditions of human enjoyment—gold, health, and immortality. By the end of the fifteenth century many important manufactures were founded by empirical experiment, with only the uncertain guidance of science. Among these were the compass, printing, paper, gunpowder, guns, watches, forks, knitting-needles, horseshoes, bells, wood cutting and copper engraving, wire-drawing, steel, table glass, spectacles, microscopes, glass mirrors backed by amalgams of tin and lead, windmills, crushing and saw mills. These important manufactures arose from an increased knowledge of facts, around which scientific conceptions were slowly concreting. Though the accumulation of facts is indispensable to the growth of science, a thousand facts are of less value to human progress than is a single one when it is scientifically comprehended, for it then becomes generalised in all similar cases. It is with the light of knowledge that we are enabled to question Nature through direct experiment. The hypothesis or theory which induces us to put the experimental question may be right or wrong; still, *prudens questio dimidium scientiæ est*—it is half way to knowledge when you know what you have to inquire.

When we examine the order of progress in the arts, even before they are illumined by science, their improvements seem to be the resultants of three conditions.

1. The substitution of natural forces for brute animal power, as when Hercules used the waters of the Alpheus to cleanse the Augean stables; or when a Kamchadal of Eastern Asia, who has been three years hollowing out a canoe, finds that he can do it in a few hours by fire.

2. The economy of time, as when a calendering machine produces the same gloss to miles of calico that an African savage gives to a few inches by rubbing it with the shell of a snail; or the economy of production, as when steel pens sold when first introduced at one shilling apiece, are now sold at a penny per dozen; or when steel rails, lately costing £45 per ton, can now be sold at £5.

3. Methods of utilising waste products, or of endowing them with properties which render them of increased value to industry, as when waste scrap iron and the galls on the oak are converted into ink; or the badly-smelling waste of gasworks is transformed into fragrant essences, brilliant dyes, and fertilising manure; or when the effete matter of animals or old bones is changed into lucifer-matches.

All three results are often combined when a single end is obtained—at all events, economy of time and production invariably follows when natural forces substitute brute animal force. In industrial progress the sweat of the brow is lessened by the conceptions of the brain. As natural forces substitute and become cheaper than slave labour, liberty follows advancing civilisation. Machines require educated superintendence. One shoe factory in Boston by its machines does the work of thirty thousand shoemakers in Paris who have still to go through the weary drudgery of mechanical labour. The steam power of the world, during the last twenty years, has risen from 11¼ million to 29 million horse-power, or 152 per cent.

Let me take a single example of how even a petty manufacture improved by the teachings of science affects the comforts and enlarges the resources of mankind. When I was a boy, the only way of obtaining a light was by the tinder-box, with its quadruple materials, flint and steel, burnt rags or tinder, and a sulphur-match. It continued to prevail till 1833, when phosphorus-matches were introduced, though I have been amused to find that there are a few venerable ancients in London who still stick to the tinder-box, and for whom a few shops keep a small supply. It required another discovery by Schrötter, in 1845, to change poisonous waxy into innocuous red-brick phosphorus, and to give us the safety-match of the present day. Now, what have these successive discoveries in science done for the nation, in this single manufacture, by an economy of time? If, before 1833, we had made the same demands for light that we now do, when we daily consume eight matches per head of the population, the tinder-box could have supplied the demand under the most favourable conditions by an expenditure of one quarter of an hour. The lucifer-match supplies a light in fifteen seconds on each occasion, or in two minutes for the whole day. Putting these differences into a year, the venerable ancient who still sticks to his tinder-box would require to spend ninety hours yearly in the production of light, while the user of lucifer-matches spends twelve hours; so that the latter has an economy of seventy-eight hours yearly, or about ten working days. Measured by cost of production at one shilling and sixpence daily, the economy of time represented in money to our population is twenty-six millions of pounds annually. This is a curious instance of the manner in which science leads to economy of time and wealth even in a small manufacture. In larger industries the economy of time and labour produced by the application of scientific discoveries is beyond all measurement. Thus the discovery of latent heat by Black led to the inventions of Watt; while that of the mechanical equivalent of heat by Joule has been the basis of the progressive improvements in the steam-engine, which enables power to be obtained by a consumption of fuel less than one-fourth the amount used twenty years ago. It may be that the engines of Watt and Stephenson will yield in their turn to more economical motors; still they have already expanded the wealth, resources, and even the territories of England more than all the battles fought by her soldiers or all the treaties negotiated by her diplomatists.

The coal which has hitherto been the chief source of power probably represents the product of five or six million years during which the sun shone upon the plants of the carboniferous period, and stored up its energy in this convenient form. But we are using this conserved force wastefully and prodigally; for although horse-power in steam-engines has so largely increased since 1864 two men only now produce what three men did at that date. It is only three hundred years since we became a manufacturing country. According to Professor Dewar, in less than two hundred years more the coal of this country will be wholly exhausted, and in half that time will be difficult to procure. Our not very distant descendants will have to face the problem—What will be the condition of England without coal? The answer to that question depends upon the intellectual development of the nation at that time. The value of the intellectual factor of production is continually increasing; while the values of raw material and fuel are lessening factors. It may be that when the dreaded time of exhausted fuel has arrived, its importation from other coal-fields, such as those of New South Wales, will be so easy and cheap that the increased technical education of our operatives may largely over-balance the disadvantages of increased cost in fuel. But this supposes that future Governments in England will have more enlightened views as to the value of science than past Governments have possessed.

Industrial applications are but the overflowings of science welling over from the fulness of its measure. Few would ask now, as was constantly done a few years ago, "What is the use of an abstract discovery in science?" The processes of mind which produce a discovery or an invention are rarely associated in the same person, for while the discoverer seeks to explain causes and the relations of phenomena, the inventor aims at producing new effects, or at least of obtaining them in a novel and efficient way. In this the inventor may sometimes succeed without much knowledge of science, though his labours are infinitely more productive when he understands the causes of the effects which he desires to produce.

A nation in its industrial progress, when the competition of the world is keen, cannot stand still. Three conditions only are possible for it. It may go forward, retrograde, or perish. In sociology, as in biology, there are three states. The first of balance, when things grow neither better nor worse; the second, that of elaboration or evolution, as we see it when animals adapt themselves to their environments; and third, that of degeneration, when they rapidly lose the ground they have made. For a nation, a state of balance is only possible in the early stage of its existence, but it is impossible when its environments are constantly changing.

The possession of the raw materials of industry, and the exist-

ence of a surplus population, are important factors for the growth of manufactures in the early history of a nation, but afterwards they are bound up with another factor—the application of intellect to their development. England could not be called a manufacturing nation till the Elizabethan age. The invasion of the Low Countries by Philip II. drove the Flemish manufacturers to England, while the French prosecution of the Huguenots added new manufacturing experience, and with them came the industries of cotton, wool, and silk. Cotton mixed with linen and wool became freely used, but it was only from 1738 to the end of the century that the inventions of Wyatt, Arkwright, Hargreaves, Crompton, and Cartwright started the wonderful modern development. The raw cotton was imported from India or America, but that fact as regards cost was a small factor in comparison with the intellect required to convert it into a utility. Science has, in the last hundred years, altered altogether the old conditions of industrial competition. She has taught the rigid metals to convey and record our thoughts even to the most distant lands, and, within less limits, to reproduce our speech. This marvellous application of electricity has diminished the cares and responsibilities of Governments, while it has at the same time altered the whole practice of commerce. To England steam and electricity have been of incalculable advantage. The ocean, which once made the country insular and isolated, is now the very life-blood of England and of the greater England beyond the seas. The colonies, being young countries, value their raw materials as their chief sources of wealth. When they become older they will discover it is not in these, but in the culture of scientific intellect, that their future prosperity depends. Higher education is the condition of higher prosperity, and the nation which neglects to develop the intellectual factor of production must degenerate, for it cannot stand still.

There is, however, one intimate connection between science and industry which I hope will be more intimate as scientific education becomes more prevalent in our schools and universities. Abstract science depends on the support of men of leisure, either themselves possessing or having provided for them the means of living without entering into the pursuits of active industry. The pursuits of science requires a superfluity of wealth in a community beyond the needs of ordinary life. Such superfluity is also necessary for art, though a picture or a statue is a saleable commodity, while an abstract discovery in science has no immediate or, as regards the discoverer, proximate commercial value. Now if our universities and schools created that love of science which a broad education would surely inspire, our men of riches and leisure who advance the boundaries of scientific knowledge could not be counted on the fingers as they now are, when we think of Boyle, Cavendish, Napier, Lyell, Murchison, and Darwin, but would be as numerous as our statesmen and orators. Statesmen, without a following of the people who share their views and back their work, would be feeble indeed. But while England has never lacked leaders in science, they have too few followers to risk a rapid march. We might create an army to support our generals in science, as Germany has done, and as France is now doing, if education in this country would only mould itself to the needs of a scientific age.

Abstract Science the Condition for Progress.—The subject of my address has been the relations of science to the public weal. That is a very old subject to select for the year 1885. In addressing you upon texts such as these, my purpose was to show how unwise it is for England to lag in the onward march of science when most other European Powers are using the resources of their States to promote higher education and to advance the boundaries of knowledge. English Governments alone fail to grasp the fact that the competition of the world has become a competition in intellect. Much of this indifference is due to our systems of education. I have ill fulfilled my purpose if, in claiming for science a larger share in public education, I have in any way depreciated literature, art, or philosophy, for every subject which adds to culture aids in human development. I only contend that in public education there should be a free play to the scientific faculty, so that the youths who possess it should learn the richness of their possession during the educative process. My contention is that science should not be practically shut out from the view of a youth while his education is in progress, for the public weal requires that a large number of scientific men should belong to the community. This is necessary because science has impressed its character upon the age in which we live, and as science is not stationary but progressive, men are required to advance its boundaries, acting as pioneers in the onward march of States. Human progress is so identified with scientific thought, both in its conception and realisation, that it seems as if they were alternative terms in the history of civilisation. In literature, and even in art, a standard of excellence has been attained which we are content to imitate because we have been unable to surpass. But there is no such standard in science. My argument is that no amount of learning without science suffices in the present state of the world to put us in a position which will enable England to keep ahead or even on a level with foreign nations as regards knowledge and its applications to the utilities of life. Take the example of any man of learning, and see how soon the direct consequences resulting from it disappear in the life of a nation, while the discoveries of a man of science remain productive amid all the shocks of empire. The discoveries of Newton will influence the destinies of mankind to the end of the world. When he established the laws by which the motions of the great masses of matter in the universe are governed, he conferred an incalculable benefit upon the intellectual development of the human race. No doubt the road upon which he travelled had been long in preparation by other men. The exact observations of Tycho Brahe, coupled with the discoveries of Copernicus, Kepler, and Galileo, had already broken down the authority of Aristotle and weakened that of the Church. But though the conceptions of the universe were thus broadened, mankind had not yet rid themselves of the idea that the powers of the universe were still regulated by spirits or special providences. Even Kepler moved the planets by spirits, and it took some time to knock these celestial steersmen on the head. Descartes, who really did so much by his writings to force the conclusion that the planetary movements should be dealt with as an ordinary problem in mechanics, looked upon the universe as a machine, the wheels of which were kept in motion by the unceasing exercise of a divine power. Yet such theories were only an attempt to regulate the universe by celestial intelligences, like our own, and by standards within our reach. It required the discovery of an all-pervading law, universal throughout all space, to enlarge the thoughts of men, and one which, while it widened the conceptions of the universe, reduced the earth and solar system to true dimensions.

Abstract discovery in science is then the true foundation upon which the superstructure of modern civilisation is built; and the man who would take part in it should study science, and if he can advance it for its own sake and not for its applications.

An established truth in science is like the constitution of an atom in matter—something so fixed in the order of things that it has become independent of further dangers in the struggle for existence. The sum of such truths forms the intellectual treasure which descends to each generation in hereditary succession. Though the discoverer of a new truth is a benefactor to humanity, he can give little to futurity in comparison with the wealth of knowledge which he inherited from the past.

THE NEW YORK ELECTRIC RAILWAY.

FOR several years past, the question of running the New York elevated railroads by electricity has been agitated. This culminated in a meeting held in New York City on the 18th of November, 1884, at which were present representatives of the Edison, Daft, Field, Siemens, Brush, and Bentley-Knight electric railways, and also of the New York elevated railway. At this, and five subsequent meetings, it was decided to test each system of applying electricity as a motive power for railways upon a certain portion of the elevated road. To pass judgment as to the relative values of the various systems, the following gentlemen were appointed to form a board of arbitrators:—Sir William Thomson, Prof. Charles R. Cross, George B. Roberts, James H. Rutter, and Robert Harris. It was, moreover, decided to finish the test, if possible, within 90 days. This time has long since elapsed, and the waiting public have heard no report.

During this time, however, a vast amount of work has been done, and great difficulties surmounted. The great delays have been occasioned by the mechanical application of the electric motor to the heavy and quickly moving trains. In the various systems to be tested, a third rail will be employed; and the laying of this, combined with its proper insulation, has consumed a vast amount of time.

In spite of all difficulties the Daft Company have completed their preparations, and are ready to start. As in other systems, the electric circuit is made from the dynamo to the central rail, through the collector to the motor, thence to the wheels and rails, and back to the dynamo. This company have laid their third rail upon the Ninth Avenue line, commencing at 14th Street. This rail is insulated by the Daft patent insulator, which prevents water from making a connection from rail to sleeper, thus insuring good insulation in all weathers. The road is further equipped by completing the electrical contacts at the joints of the outer rails.

At the end of this line the company have located their central station. They have placed in position a large William Wright engine, with the necessary boilers and shafting. Two 50 horse-power Daft dynamos are now in position, and, later, a third will be erected to relieve the others in case of accident. The wires are carried from the station to the rails through the streets upon poles.

The motor, Benjamin Franklin, has been for some

weeks finished, and has been thoroughly tested. The motor is 14 feet 6 inches long, and 6 feet 9 inches wide, and weighs 9 tons. The schematic drawing (fig. 1) will show the manner in which the motor is arranged. No attempt is made here to reproduce the proportions of the Benjamin Franklin. One of the largest-sized Daft motors, M, M, is mounted upon the truck, F, F. The motor is hung so that it turns about N as an axis. The other end is supported by the screw, H. The maximum capacity of this motor is 300 ampères, with an electromotive force of 185 volts. The power is transmitted from the motor to the wheels by the grooved friction gearing, P and D, D. P is keyed to the armature shaft, and D, D, to the driving wheel shaft. The flange of the driving wheel, on the farther side, is shown at W. These gears are duplicated on the other side of the motor. The amount of pressure upon the friction gears is regulated by the screw, H. This screw is also advantageous in case of repairs, for by means of it the motor may be moved completely off its friction bearings. The support, N, of one end of the motor, is cushioned with heavy strips of rubber, as is also the cap, T, upon which the screw rests. The trucks are likewise cushioned, thus allowing freedom of motion in any direction, and insuring perfect accommodation, on the part of the motor, to any irregularities in the road bed.

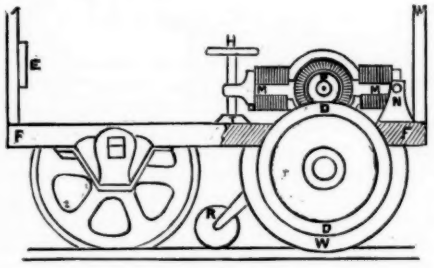


FIG. 1.

The connection with the middle rail is made by means of a heavy bronze wheel 14 inches in diameter, R. This being fastened to an arm, may be raised or lowered, thus allowing discontinuities in the central rail, of which there are several in the Ninth Avenue line, to be safely passed. The wiring is all underneath the frame, and is enclosed in wooden sheathing. The device for controlling the motor is placed at the end of the cab at E. This is a device of sliding contacts, worked by a handle similar to the throttle in the locomotive cab, which raises or lowers the resistance in the field-magnet circuit, thus varying the amount of current, and consequently the strength of field and speed of motor. There is also a complete cut-out in circuit. The motor is thus under complete control, it being possible to run fast or slow. The motor may be stopped either by the cut-out, or by lifting the contact wheel. The system is further provided with an automatic cut-out, which breaks the circuit when the current reaches a certain strength, at the same time ringing a bell at the central station, warning the engineer at the central station that there is trouble on the road.

The reversing gear is simply four brushes connected by suitable links, so that a movement in one direction applies one pair of brushes, while a movement in the other applies the opposite pair. In the motor Benjamin Franklin, the ordinary hand brake will be employed; but later, some form of air or electric brake will be used. This motor is a very substantial affair, as its weight (9 tons) would show. The experiments will be performed as soon as Mr. Daft is at leisure to commence them.

The Edison and Field Companies have combined, and are preparing to test their system upon the Second Avenue line, The length of this line from Chatham Street to Harlem is 7·44 miles, only part of which, however, will be traversed by the electric railway. Although this company have not brought their work so near completion as the Daft Company, still they have done a deal of hard work. They have located their central station upon 24th Street, and have provided there a 250 horse-power Whitehill & Smith engine, with the necessary boilers and shafting. The Edison dynamos have not yet been set in position, nor has any wiring been done.

In this system the central rail has to be very carefully insulated on account of the comparatively high electromotive force employed (some 600 volts). To this end the rails will be insulated by resting upon glass shoes, which will be protected from the jar of passing trains by a thin strip of rubber. As the glass shoes have not been delivered, the rails have not been laid.

The work upon the motor has progressed slowly on account of the many difficulties offered. The original arrangement shown in the *New York World*, April 26th, 1885, has given way to several newer forms suggusted by it. The latest form, and the one to be completed, is shown in the schematic drawing (fig. 2).

In this system every truck will be provided with a motor, thus making every car independent. In fig. 2, A is the bottom of the car, T is the ordinary railway truck used upon any car. To apply the motor, the truck is prolonged to B, and is supported by the spring, S. This spring is hung from a roller capable of side motion, thus allowing the truck to accommodate itself to curves. The motor used is a compound wound

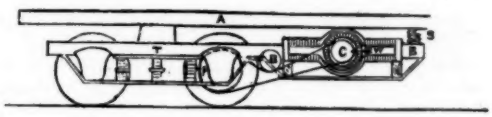


FIG. 2.

Siemens, and is so designed that, with an external electromotive force of 600 volts, it will revolve at a constant speed of 600 revolutions per minute. The power is transmitted from the armature to the pulley, C, by means of a Weston friction clutch. This friction clutch, W, is worked by a wheel similar to the ordinary brake wheel, one wheel working both friction clutches of one truck. The power is transmitted from the pulley, C, to the pulley, P, keyed to the axle of the driving wheels by means of a heavy leather belt of peculiar construction. In order to obtain more bearing surface for the belt, it is carried around the pulley, B. This same arrangement is reproduced on the other side of the truck.

The motor itself is movable, so that the tension of the belt may be varied at will. The contact with the middle rail is made by means of brushes sliding upon it. The brushes are mounted on the ends of a bar which prevents their dropping down when another road is passed, and thus short circuiting the track. The brushes are held in position by springs which allow them to turn, and thus insures a drag of the brushes at all times, instead of a push, thus allowing the joints in the rails to be smoothly passed. The reversing is accomplished as in the Daft, by employing an extra pair of brushes. The speed of the car will be controlled by the friction brake, the motor running constantly at a uniform speed. The Eames vacuum brake will be employed, the pump of which will be run by the motor.

It will be seen from the above, writes Mr. F. A. Pickernell in *Science*, that the Edison-Field combination are working upon a new principle. This system will have many advantages peculiar to itself. Each car will be independent, and the cars composing the train will start off simultaneously, thus relieving the elevated structure of the great strain caused by the locomotive when starting. The constantly revolving armature, on account of its high speed, and consequently great momentum, will help start the train, thus relieving the engine at the central station of sudden

and great strains. As the load on the car increases, the traction likewise increases. The weight, moreover, of a train of this kind, is more evenly distributed than in one moved by a locomotive.

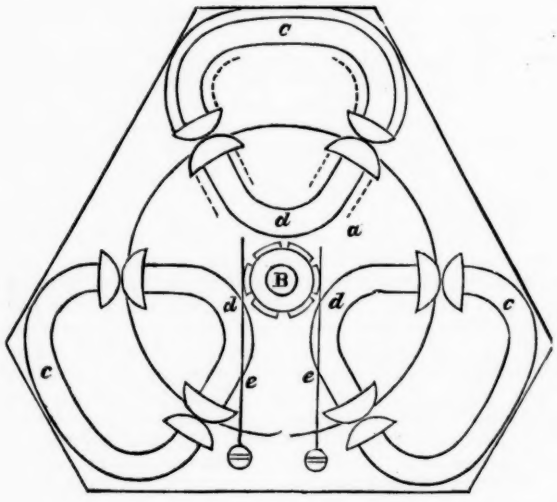
The electric motor, in general, possesses advantages which are of special value on an elevated road. It is possible to balance an electric motor, thus relieving the structure of the constant vibration caused by the quickly-moving locomotive. Its freedom from dust and smoke, as well as its economy, insure its immediate introduction.

Although the progress in introducing the electric motor on the New York elevated railway has not been so rapid as had been anticipated by enthusiasts, still the progress has been steady, and in the right direction. It is, perhaps, remarkable, that more companies have not commenced operations; but when the magnitude of the task is realised, and the patents held by a few parties are inspected, the reason is seen. However, several other companies intend to commence operations in the immediate future, the plans of which are now maturing.

A PRIMITIVE ELECTRO-MAGNETIC ENGINE.

F. G. WOODWARD, in the *American Machinist*, gives the following description of an electro-magnetic engine, constructed years ago, and which we illustrate on this page :—

"I recently discovered, among some old drawings, a sketch of a magnet engine which I saw in operation in Boston a little more than forty years ago, which, at this day of electricity, may be of interest to some of your readers. The lively, energetic action of this little machine so interested me that I at once made a sketch of it, and subsequently (while at the Rensselaer School of Troy in 1839) I made a more complete drawing of the machine, the present illustration being a reduced copy of the same. It was a small affair, the rotating



wheel, *a*, being only about five inches in diameter, the whole thing being composed of six electro-magnets, viz. : three stationary ones, *c*, and three rotating, *d*, the rotating ones being fixed to the vertical shaft, B. The magnets were made of ½-inch soft round iron with a sort of triangular head, as shown, and wound with a few turns of insulated copper wire near their heads as indicated by dotted lines.

"The six magnets were all charged by a single battery about the capacity of a quart mug ; the battery consisting of a copper cup containing several concentric circles or cylinders of zinc and copper alternately, requiring about a pint of dilute acid for a charge.

"The alternate attraction and repulsion which caused the wheel to rotate, was brought about by six copper segments seen around the shaft, B, the segments having no metallic connection with the shaft. The ends of the wire covering the rotating magnets were soldered to the segments in such a way as to cause the continuous changing of their polarity six times in each revolution. Two copper springs, *e*, resting slightly in contact with the segments, served as conductors from battery to magnets, *d*, through the medium of the segments. The shaft, B, carried a small bevel gear which worked a larger gear, not shown, the proportion being about 1 to 12. The horizontal shaft which carried the large gear being smoothly finished and about ⅜-inch in diameter, offered a good chance to test the power of this little machine. I saw no one capable of stopping it by grasping this shaft with a single hand."

NATIONAL ELECTRIC LIGHT ASSOCIATION OF AMERICA.

THE American National Electric Light Association met at the Hotel Dam, New York, for the purpose of holding a convention, on Tuesday, August 18th, Mr. J. F. Morrison, president of the Brush Company, Baltimore, occupied the chair, and there was a large attendance of electric light men and representative dealers in electric light apparatus.

The PRESIDENT, in calling the meeting to order, intimated the lines on which the convention would be conducted, and after this a discussion took place as to what constituted a right to vote, the matter in the end being referred to a committee, which on the following day recommended that "Members of this Association shall be persons, firms or corporations engaged in the lighting business, to wit, that of supplying electric lights from a station to public or private consumers, as distinguished from such as are operating private plants or engaged in the manufacture or sale of electric machinery, apparatus or supplies." This recommendation was adopted.

Mr. RIDLON having succeeded in getting carried a motion empowering the chairman to appoint a committee, to consist of one representative from each system represented in the association, to consider the question of maintaining, by the several manufacturing and lighting companies, a uniformity of prices for electric lighting apparatus and supplies,

Mr. GEO. S. BOWEN, of Elgin, Ill., spoke in an entertaining strain on the history and applications of electricity.

Mr. A. F. UPTON, of the Jarvis Furnace Company, followed with an excellent paper on the subject of power used in electric lighting.

Mr. W. W. LEGGETT then read an interesting paper on tower lighting in towns and cities. He objected to arc lighting on poles at low altitudes, as the light was obscured by foliage, was too dazzling and had an unpleasant effect on the eyes, and was too expensive. In favour of tower lighting he urged among other things that back yards and alleys were lighted almost as well as the streets.

Dr. OTTO A. MOSES, of new York, addressed the meeting on the subject of "Incandescence." He said they had in incandescent lighting an infant of seven years old that he thought was going to strangle gas with one hand and petroleum with the other. He was competing with gas lighting and also with arc lighting, and he thought it was too much to expect that he was going to stop growing in his seventh year.

A short general discussion followed, and the convention adjourned for the day.

At Thursday's session it was decided that the next meeting should take place at Baltimore, Md., in February, 1886.

It was then resolved "That the office of this association shall be located in Baltimore, and be the repository of all matters pertaining to the subject of electric light-

ing, motive power and kindred subjects, and that correspondence be solicited with all foreign and home associations, all of which shall be placed on file, subject to the use of the members of the association."

A committee consisting of Messrs. R. W. Pope, W. J. Johnston and Geo. Worthington (all three of whom are connected with electrical journalism) was appointed to invite prominent electricians of foreign countries to become associate members.

Mr. E. A. SPERRY, of Chicago, presented a paper on "The best form of dynamo." Mr. SPANG, in the discussion which followed, spoke in favour of the Ball unipolar dynamo, and introduced a resolution appointing a committee to invite manufacturers of dynamos to send machines to be tested by them, which was adopted.

Mr. RALPH W. POPE, of the *Electrician and Electrical Engineer*, read a paper on "Placing wires underground," which provoked an interesting discussion.

The following committees were appointed to report on the subjects named at the next convention :—

Electricity as an illuminant—Messrs. Bowen, Chicago; Moses, New York; Sperry, Chicago; Cleveland, Hartford; and Holt, Cleveland.

Proper construction and maintenance of wires—Messrs. A. J. Holt, Cleveland; A. J. Dalzell, Hartford; P. Fahay, Boston; S. A. Duncan, Pittsburgh; E. R. Weeks, Kansas City.

Steam power—Messrs. Ide, of Springfield; D. E. Evans, Baltimore; De Camp, Philadelphia.

Underground lines—Messrs. Ralph W. Pope, New York; E. A. Sperry, Chicago; W. R. Patterson, Chicago.

Incandescent lighting—Dr. Otto A. Moses, and others.

History and progress of electric lighting—George Worthington, *Electrical Review*.

History and progress of electricity as applied to motors—W. J. Johnston.

Electric lighting in Canada—C. A. Ross, Montreal, Canada.

Measurement of high-tension currents, Best instruments for—C. J. Van Depoele, Chicago; Prof. Thomson and E. J. Houston, of Philadelphia.

Best equipment for arc lighting stations—D. E. Evans of Baltimore, and N. S. Possens, Cleveland.

Operating expenses—E. R. Weeks, Kansas City; A. J. De Camp, Philadelphia; D. W. Guernsey, St. Louis; George O'Connor, New Orleans; E. H. Goff, New York; H. C. Tudor, Baltimore, Md.

Line wire, best for overhead lines, size, insulation, &c.—H. M. Cleveland, Hartford.

Carbons and globes—Frank Ridlon, Boston; and others.

Storage batteries—A. J. Holt and George H. Benjamin.

Motors—Charles J. Van Depoele and Wm. Hochhausen.

Arc lighting—Wm. Hochhausen.

ELECTRIC STREET RAILWAY IN PHILADELPHIA.

THE president and directors of the Ridge Avenue Passenger Railway Company, Philadelphia, have given permission to the American Electric Railway Company to lay a conduit and experimental line on Ridge Avenue, from the depot at Dauphin Street to Laurel Hill Cemetry. The work of laying the conduits and conductors for the electricity will begin in about a month, we learn from the New York *Electrical Review*. The work will be under the supervision of Mr. W. M. Schlesinger, an English electrical engineer.

One car, provided with a motor, will be run at first, and this will not interfere with the trips of the regular horse cars. The car will be one of the ordinary cars altered for the purpose, and will carry as many passengers as usual, the idea being to give the two motive powers a fair test, the claim being that the electrical is greatly the cheaper. The conduit will be laid so as to avoid interference with the travel of the horses, and the tracks will not be disturbed.

In shape the conduits will somewhat resemble those laid by the Traction Company, but will be of heavy timber, instead of iron, below ground. It will be braced inside with iron knees and provided with drainage facilities. Running along beneath the top will be the compound conductor of copper and iron, half circular in shape, well insulated and protected from damage from outside influences. On the top of the conduit forming each side of the slot, which will have a half-inch opening, will be iron plates about five inches in diameter altogether. This slot opening will not be directly in the centre of the track, but to one side of the meridian line.

The current will be transmitted by an ingenious contrivance from the conductor underground to the motor in the car, and will be under instant control of the driver or engineer. At intervals of 18 feet, plates will be arranged over the conduit, which may be readily removed for repairs and other work, and without removing the body of the conductor. The bottom of the conduit will be cemented previous to filling in the ground about it. A speed of seven to ten miles an hour is claimed for the experimental Ridge Avenue line, and a saving of $2.50 to $3 per car over horse power. The engineers are sanguine of the success of the electrical street railway.

ON AN UNNOTICED DANGER IN CERTAIN APPARATUS FOR THE DISTRIBUTION OF ELECTRICITY.

By J. HOPKINSON, F.R.S.*

MANY plans have been proposed, and several have been to a greater or less extent practically used, for combining the advantage of economy arising from a high potential in the conductors which convey the electric current from the place where it is generated with the advantages of a low potential at the various points where the electricity is used. A low potential is necessary where the electricity is used; partly because the lamps, whether arc or incandescent, each require a low potential, and partly because a high potential may easily become dangerous to life. Amongst the plans which have been tried for locally transforming a supply of high potential to a lower and safer, the most promising is by the use of secondary generators or induction coils. It has been proved that this method can be used with great economy of electric power and with convenience; under proper construction of the induction coils it may also be perfectly safe. It is, however, easy and very natural so to construct them that they shall be good in all other respects but that of safety to life—that they shall introduce an unexpected risk to those using the supply.

In a distribution of electricity by secondary generators an alternating current is led in succession through the primary coils of a series of induction coils, one for each group or system of lamps. The lamps connect the two terminals of the secondary coil of the induction coils. It is easy to so construct the induction coils that the difference of potential between the terminals of the secondary coils may be any suitable number of volts, such as 50 or 100; whilst the potential of the primary circuit, as measured between the terminals of the dynamo machine, may be very great, *e.g.* 2,000 or 3,000 volts. If the electro-magnetic action between the primary and secondary coils, on which the useful effect of the arrangement depends, were the only action, the supply would be perfectly safe to the user so long as apparatus with which he could not interfere was in proper order. But the electro-magnetic action is not the only one. Theoretically speaking, every induction coil is also a condenser, and the primary coil acts electrostatically as well as electromagnetically upon the secondary coil. This electrostatic action may easily become dangerous if the secondary generator is so constructed that its electrostatic capacity, regarded as a condenser, is other than a very small quantity.

Imagine an alternate current dynamo machine, its terminals connected by a continuous conductor, on which may be resistances, self-induction coils,

* From the Journal of the Physical Society.

secondary generators, or any other appliances; at any point is a condenser, one coating of which is connected to the conductor, or may indeed be part of it, the other is connected to earth through a resistance. Let K be the capacity of the condenser, V the potential at time, t, of the earth coating of the condenser, U the potential of the other coating, x the current in resistance, R, to the condenser from the earth, being taken as positive, and the earth potential as zero. We have

$$x = \frac{V}{R},\quad K\,(U - V) = x;$$

whence, since

$$U = A \sin. 2\pi n t,$$

where A is a constant depending on the circumstances of the dynamo circuit as well as the electromotive force of the machine, and n is the reciprocal of the periodic time of the machine, we have

$$K R x + x = 2\pi n K A \cos. 2\pi n t,$$

$$x = \frac{2\pi n K A}{(K R 2\pi n)^2 + 1}\{-2\pi n K R \sin. 2\pi n t + \cos. 2\pi n t\},$$

mean square of

$$x = \frac{2\pi n K}{\sqrt{(K R 2\pi n)^2 + 1}} \text{ . mean square of A.}$$

Let us now consider the actual values likely to occur in practice. Let the condenser be a secondary generator; let the resistance, R, be that of some person touching some part of the secondary circuit, and also making contact to earth with some other part of the body; n may be anything from 100 to 250, say 150; K will depend on the construction of the secondary generator—it may be as high as 0·3 microfarad or even more, but there would be no difficulty even in large instruments in keeping it down to one hundredth of this or less. The mean square of A will depend on the circumstances of other parts of the circuit; it might very easily be as great, or very nearly as great, as the mean difference of potential between the terminals of the machine if the primary circuit were to earth. Suppose, however, that the circuit is symmetrical, that a secondary generator is at one end, and that another person of the same resistance as the person at that point is touching the secondary circuit of the secondary generator at the other end of the circuit. In that case, if 2,400 be difference of potential of the machine, mean square of A will be 1,200; in which case we have, taking R as 2,000 ohms, mean square of

$$x = \frac{2\pi \times 150 \times 0{\cdot}3 \times 10^{-6}}{\sqrt{(2\pi \times 150 \times 0{\cdot}3 \times 10^{-6} \times 2000)^2 + 1}} \times 1200$$

= about 0·3 ampère.

Experiments are still wanting to show what current may be considered as certain to kill a man, but it is very doubtful whether any man could stand 0·3 ampère for a sensible length of time. It is probable that if the two persons both took firm hold of the secondary conductors both would be killed. If the person at the far end be replaced by an accidental dead earth on the secondary circuit, the person at the first point would experience a greater current than 0·3 ampère.

It follows from the preceding consideration that secondary generators of large electrostatic capacity are essentially dangerous, even though the insulation of the primary circuit and of the primary coils from the secondary coils is perfect. The moral is—for the constructor, take care that the secondary generators have not a large electrostatic capacity, say not more than 0·03 microfarad, better less than $\frac{1}{100}$ microfarad; for the inspector, test the system for safety. The test is very easy. Place a secondary generator of greatest capacity at one end of the line and connect its secondary circuit to earth through any instrument suitable for measuring alternate currents under one ampère; put the other end of the primary to earth; the reading of the current-measuring instrument should not exceed such a current as it may be demonstrated a man can endure with safety.

THE MANUFACTURE OF GLOW LAMPS.

By H. MICHAELIS.

A NEW process for producing a vacuum in the glass globes of incandescence lamps has just been patented in Germany by M. Wellstein of Berlin. This process will enable the same glasses to be continually employed even when the filament has been entirely consumed.

The subjoined figure from *La Lumière Electrique* gives an explanation of the process. The glass globe, A, open at its lower part, is fixed, hermetically closed, upon an exhaustion apparatus after the stopper, g, has been introduced. The stopper, g, traversed by the filament, j, j, is coated with caoutchouc or some other insulating material. An elastic band, e, e, tends to press the stopper into the neck of the glass. At the moment when the exhaustion ceases the stopper is pressed hermetically against a, a, by atmospheric pressure.

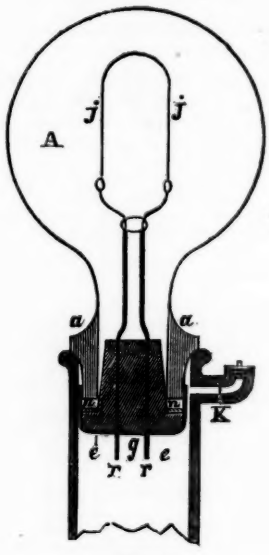


FIG. 1.

To avoid the diffusion of the external air into the interior of the glass, the inventor recommends to put a slight layer of deoxidised cement around the surface of the coating of the stopper. The exhaustion apparatus is fitted with an elbowed pipe, K, which has a

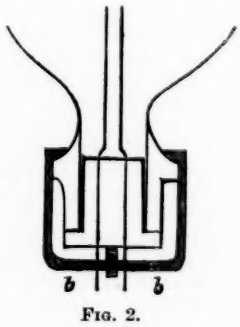


FIG. 2.

valve or other analogous arrangement.

To secure the closing caused by atmospheric pressure, the stopper may be kept in its place by a clamp or a screw (fig. 2).

Atlantic Telegraphy.—The main cable of the Compagnie Française du Télégraphe de Paris à New York is now repaired, and communication by their lines with the United States restored.

INCANDESCENT LAMPS ON AMERICAN RAILWAYS.

FOR several months past, the Pennsylvania railroad company has been lighting nine cars with incandescent electric lamps. The electricity is produced by Brush storage batteries, which are charged once a week. The storage battery is carried underneath the cars in boxes built to receive them—one-half being placed on each side. Each car requires six trays of four cells each. The trays are so made that the simple process of putting the trays in position completes the electric circuit. The battery when charged has an electromotive force of 45 volts; and when the electromotive force has fallen to 39 volts, the battery is recharged. The batteries are charged at the depot in Jersey City by a 16-light Brush machine. In charging, the ordinary Brush manipulator, without the register, is employed.

We read in *Science* that Swan lamps consuming 1·1 ampères have been used almost exclusively, although Stanley-Thomson's lamps have been tried. The parlour cars require ten 16-candle power lamps, while the passenger cars require but six. The lamps are all in parallel circuit, and so arranged that one-half may be used at a time. The wires are led through a clock mechanism, which registers the time they have been used. By an ingenious mechanical device, the clock is made to move half as fast when the switch throwing off half the lamps is turned.

Altogether, some 17 batteries of 24 cells each are in use; and, as yet, only one cell has been disabled. As to loss of efficiency, due to deterioration, no tests have been made. Although the lamps are probably much less than 16-candle power, it is probable that their life is less than that of those used in buildings, because of the jarring to which they are subjected.

It is claimed that the cost of lighting the cars by the incandescent lamp compares favourably with that of lighting by compressed gas. During the heavy storms which prevailed during the first week of August, 48 cells of these storage batteries did the work on a telegraph line which 500 gravity cells failed to accomplish.

THE BLACKPOOL ELECTRIC TRAMWAY.

WHEN the Board of Trade sent down Major-General Hutchinson, R.E., to inspect the tramway line at Blackpool, he was accompanied by Major Armstrong, R.E., whose special duty it was to report upon the "electrical" portion of the tramway. This has been done, and a copy of his report forwarded to the Local Authorities at Blackpool, the particulars of which are just to hand. Major Armstrong, according to the *Mechanical World*, was provided by the engineer with all the necessary electrical details of the line, and the methods adopted for safety, which he thinks will, "if carried out in all the cars, and throughout the entire length of the track, be sufficient to protect the public from danger or inconvenience through the employment of electricity as a method of propulsion." With reference to the conductor, it may be remarked that it consists of two copper insulated rails placed underground, with an upper metallic screen plate (connected to earth) intervening between the rails and the traffic along the road. The line will be worked at an electromotive force of 250 volts; this potential Major Armstrong considers "would, indeed, be too high to be permitted in a rail laid in the middle of the road, were it not for the provision of the 'earthed' metallic screen, which prevents the public from coming in contact with it."

Relative to this point he continues: "In the dry weather during which the examination was made, the combined action of the insulation of the rails and the earthing of the screen plate was such as to prevent any electrical action whatever being detected by my touch, so that under these circumstances it is manifest that no inconvenience would be felt by the public.

"In wet weather two changes will occur—viz., (*a*) There will be leakage from the insulated rail; (*b*) the earthing of the screen plate will gradually become more perfect.

"It is just possible that at some stage of the above process, the leakage might not be all carried to earth, and, as horses are so very sensitive to electric shocks, I would like to try this again in wet weather—possibly more than once."

In conclusion Major Armstrong recommends that the electrical working of the line should be carried on according to certain recommendations which are contained in a paper accompanying the report, of which we give the following extracts:—

"The engine, or engines, which drive the dynamo generators shall be governed by governors approved by the Board of Trade, which shall prevent the speed varying more than ten per cent."

"The charged rail shall be so insulated, and the metallic screen plates shall be connected to earth as shall be directed by the Board of Trade, from time to time, with a view of preventing persons touching the latter from receiving shocks."

"The magnetic field of the generator shall be independently excited, and shall not be connected with the charged rail."

"Effective insulation shall be provided between the passengers in the car and all points in metallic connection with the charged rail."

"The foregoing includes the switches and the reversing plugs. In the car examined on the 29th ult., some further insulation of the reversing plugs was desirable."

"Should the collector become detached in any way, it will be so insulated that a person touching it will not receive a shock."

Major-General Hutchinson, in forwarding the report, freely concurs; he considers that the governor on the stationary engine will be quite sufficient, without requiring one on each car, and also that an electric brake will not be necessary. However, he is of opinion that each car should be provided with a speed indicator.

The resetting of the line is being rapidly proceeded with, and will be finished about the middle of September. The engines and dynamos have been tried satisfactorily, and several of the cars have been run on a short length outside the engine station. The solution of this enterprise, says our contemporary, is now clearly at hand.

THE EFFICIENCY AND DURATION OF INCANDESCENT LAMPS.

THE report of the Committee of the Franklin Institute of America on the efficiency and duration of various types of incandescent lamps is now published in the Institute Journal, and it is believed that the examination has been more complete and the report more thorough than anything which has hitherto appeared on the subject. The members of the committee were J. B. Murdock, Lieut. U.S. Navy; Louis Duncan, Ph.D., Ensign U.S. Navy; Professor William D. Marks, of Pennsylvania University; and George M. Ward, M.D., photometric expert to the Philadelphia Gas Works.

The scheme for a duration or life test of incandescent lamps was organised during the Electrical Exhibition of last year by the executive committee.

The board of managers of the Franklin Institute placed the conduct of the tests in the hands of its president, who authorised preparations for conducting the test on a larger scale than was possible during the continuance of the Electrical Exhibition. Three rooms in the exhibition building were set apart for the test.

A code had been prepared, specifying how the test

should be conducted. This code was signed in December by Mr. Weston and Mr. Upton, representing the interests of the United States and the Edison companies. The Brush-Swan and the Bernstein companies declined to enter their lamps. The Franklin Institute entered a lot of Woodhouse and Rawson lamps, obtained from the Van de Poele Company, and also two grades of the Stanley-Thompson lamp, made by the Union Switch and Signal Company, of Pittsburg. The president of the Franklin Institute subsequently entered, for efficiency measurements, and for such a test of duration as circumstances would permit, a lot of Weston lamps (paper carbon), furnished by Mr. Weston; a lot of Woodhouse and Rawson lamps, received from the Edison Lamp Company, and a lot of White lamps, from the Electrical Supply Company.

In order to secure satisfactory results, and prevent needless discussion, the following code was agreed upon for the conduct of the test :—

Proposed Code for Duration Test of Incandescent Lamps to be made by the Franklin Institute of the State of Pennsylvania.

The parties hereto subscribing do agree to accept the services of the examiners herein named, and to abide by the method adopted for the test, and by the results obtained, without appeal.

NAMES OF EXAMINERS.

Lieut. J. B. MURDOCK, U.S.N. | Ensign L. DUNCAN, U.S.N.
Prof. WM. D. MARKS. | Dr. G. M. WARD.

Each company to enter twenty lamps. The examiners will select fifty lamps from a supply furnished by the companies, of not less than one hundred lamps. Twenty of these will be used in the preliminary adjustment of the circuit, and then replaced at the beginning of the test by twenty similar ones, until then unused, save for preliminary determinations.

A preliminary test of each lamp under normal conditions will be made before the beginning of the continuous test, and the time used will be credited to each lamp.

This preliminary test will determine the spherical intensity of the illumination and the reduction factor.

The Franklin Institute shall have the right to enter lamps of different kinds for the test, such lamps to be treated in all respects as though entered by a competing company.

The difference of potential between the mains will be kept at 120 commercial volts. Weston's incandescent automatic regulator will be used, and no other adjustment of the potential of the mains will be attempted, save in the case of wide variation. A voltmeter will be kept in circuit all the time.

A resistance of German silver wire will be placed in circuit with each lamp, and a preliminary adjustment made, to give the lamp its proper difference of potential.

Exhibitors will give the potential required by their lamps. Unless the lamps are separately marked, all lamps of the exhibitor will be considered as exactly similar.

An Edison "T" dynamo, driven by a Porter-Allen engine, will be used. The circuit will be opened occasionally and the lamps allowed to cool.

Lamps shall be considered as out of the test when they fail to burn, whether due to breaking of glass or filament. When a lamp gives out, it will be replaced by one requiring substantially the same difference of potential. The first three lamps of each company which are broken shall be replaced by others for which the preliminary measurements have been made, to be used only in case of accidental breakage.

The test may be declared ended at any time when in the opinion of the committee one system is so far in advance that a longer test could not change the result.

MEASUREMENTS.

Measurements of currents, difference of potential between terminals of lamp, and photometric intensity, will be made. The lamps will be arranged in a circle, having the photometer bar for a radius, and will be placed with the plane of the loop perpendicular to the bar. All measurements will be reduced to mean spherical intensity, by multiplying the intensity measured, by a reduction factor determined for each lamp. Photometric measurements will be made as necessary, but not oftener than once daily.

Electric measurements will be made daily.

A record will be kept of each lamp, in which all data relating to it will be entered.

Weekly reports will be made to the Franklin Institute of the observations made, and showing how long each lamp has been under test.

METHODS.

The legal ohm will be considered the standard of resistance. The ampère will be determined by the silver voltameter, and checked by calculation of the constant of the current galvanometer used. The volt will be taken as that E.M.F. which produces a current of one ampère in a resistance of one legal ohm. The ampère equivalent of silver as determined by Lord Rayleigh will be accepted as correct.

Currents will be measured by a tangent galvanometer, the constant of which will be determined by the silver voltameter, and checked by calculation.

A standard resistance of German silver wire wound on a reel will be carefully measured in turpentine or neutral oil, the temperature being observed. The potential galvanometer may be calibrated by connecting to the terminals of this resistance while a current simultaneously measured is passing through it. The temperature of the liquid will be observed and the resistance corrected therefor.

Calibrations will be made frequently during the tests.

Potential may be measured by a mirror galvanometer in a shunt circuit of high resistance.

Each company will be permitted to have one authorised representative in attendance throughout the test, and every facility will be given to those representatives to inspect the working of the test that will not interfere with its progress.

The Franklin Institute agrees to keep the lamps under proper surveillance, and to take necessary precautions for their safety. Lamps accidentally broken will not be charged against the companies.

The right is reserved to discontinue the test at such times and for such periods as may seem advisable or necessary.

A preliminary test will be made before the actual test begins, to insure good working.

In case any objection be made, or difference of opinion should arise between the committee and the contestants, the unanimous vote of the committee shall be final.

If, however, there be not a unanimous vote, the minority of the committee shall appoint one referee and the majority another; these two shall appoint a third referee.

The decision of a majority of these referees shall be final.

(Signed) FRANCIS R. UPTON.
United States Electric Lighting Company,
per EDWARD WESTON, *Electrician.*

The test began with the following lamps entered :

20 Weston	... ...	110¼ volts.	Tamadine carbon.
20 Edison	...	94–100 „	
10 Woodhouse & Rawson		55 „	
10 Stanley-Thompson...		96 „	
10 „	„ ...	44 „	

The latter lamps were requested to be entered at 16 candle-power. The committee, after a preliminary trial of several of the lamps, fixed on the potentials of 96 and 44 volts respectively, for the two grades, as approximately representing that candle-power, and the lamps were entered at these potentials.

No official information was furnished the committee as to the process of manufacture of any of the lamps.

The Weston lamp entered by the United States Electric Lighting Company has what has been called a "tamadine" carbon. The committee was not furnished with any official information as to the manufacture of the lamp, but the main features were shown by Mr. Weston in his private exhibit at the exhibition, afterwards presented by him to the Franklin Institute. Gun-cotton in the form of flat sheets was treated chemically to separate the nitryl from the cellulose. The resulting cellulose product is a tough, firm, translucent substance from which the strips are cut in a sinuous form and carbonised. The carbon is rectangular in cross section, but is placed in the lamp so that at the shanks the longer side of the rectangle is in the line of the shanks, instead of at right angles as in most other lamps. The connections are made at the terminals with minute steel screw bolts and nuts setting up with platinum washers. The bending of the carbon turns the long side of the rectangle so that it lies in different directions at different points.

The lamp is mounted on a wooden base surrounded by a brass ring. The wires are led down through holes in the wood to the bottom of the base, where one is soldered to a ring and the other is held in place by a small screw, which is concentric with the ring and projecting below its plane. The socket contains two spring clamps against which the terminal ring and screw of the lamp press, the lamp being held in place by a lug on the brass ring fitting into a groove in the socket. The lamps and sockets in the test were readily interchangeable, and the connections were good throughout.

The Edison lamps were similar in appearance to those generally used. The carbon was made from bamboo fibre. The lamps were mounted in the ordinary screw socket, which gave good contact with great facility of handling.

The Woodhouse and Rawson lamps displayed good workmanship and were quite simple in construction. The carbon, which is rectangular in cross section, is cemented by a very neat joint to two platinum wires, which are kept apart by a glass bridge, and then passing through the base of the lamp have small loops formed in their ends, the loop being made rigid by imbedding the ends in the glass. Two spring hooks in the socket hook into these loops making contact. The lamps in the test were used with Swan sockets. The loops at the base of the lamp seem liable to injury. Two lamps were disabled by the breaking of these loops before the beginning of the test for duration. No information as to the nature of the carbon was in possession of the committee. Each lamp had the firm name marked on the glass.

The Stanley-Thompson lamps had carbons apparently made from thread. No information was given other than that the lamps were made under the Stanley-Thompson patents.

The small, or 44 volt lamp, was well made, so far as the glass

work was concerned, the carbon being cemented to platinum wires which were kept apart by a glass bridge and then passed through the base of the lamp. The glass bulb of the lamp was set in a hollow in a wooden base and most insufficiently secured by a cement apparently of plaster of Paris. The wires went through the wood to two small screws. Much difficulty was caused by the cement giving way, so that the wires formed the only attachment of the lamp to its base. The lamp was secured in its socket by two brass bars projecting from the sides of the wooden base, fitting into slots in a brass cylinder socket. Connections were made by two springs at the bottom of the socket pressing against the screws in the base of the lamp. The sockets were not satisfactory, not being interchangeable readily, and difficulty was constantly met with in shifting the lamps. Several cases occurred of partial carbonisation of the wooden base between the wires, causing bad leaks, and in one case it had gone so far as to attract attention by the wood's smoking. The wooden bases were blackened, and the leak may have begun over this blackened surface. The difficulties met with in the 44 volt lamp were also encountered in the 96 volt. In addition there seemed to be a point of weakness in the base of the glass bulb, several of the globes breaking at that point after the cement gave way. These accidents occurred in fitting the lamps to their socket for the test of duration.

All of the above lamps except the Edison bore evidences of the carbons having been "treated" by a deposit from a hydrocarbon gas. The deposit on the Weston carbons was but slight.

After the test for duration had continued about five hundred hours, the Franklin Institute entered three new lots of lamps as already stated. These were

10 Weston lamps (paper carbon)	... ...	70 volts.
10 Woodhouse-Rawson lamps	... ...	50 „
10 White lamps	... ...	50 „

The Weston lamps were the same in general appearance as the 110½ volt lamps. The carbon, it is understood, is made from paper and subsequently treated to very heavy deposits from a hydrocarbon gas.

The Woodhouse-Rawson lamps were received indirectly from the manufacturers, and were similar in appearance to those already tested, but were more uniform.

The White lamps were somewhat similar to the Woodhouse-Rawson, in external appearance, but the bulb was somewhat longer and narrower. The carbons were cemented to platinum wires, which were separated by a glass bridge, and had loops in their ends for hook connections in a spring socket. No details of the manufacture of these lamps were furnished.

The currents were furnished by an Edison "T" dynamo, worked by a Porter-Allen engine kindly loaned for the test by the Southwark Foundry. Steam was obtained from a locomotive boiler, the property of the Franklin Institute. The potential was controlled by a Weston automatic regulator, which kept it within about a volt on either side of the normal. Three Edison bridge indicators were in use in different parts of the circuit. They agreed in their indications and proved to be very sensitive. A registering telemanometer recorded all variations of steam pressure with great accuracy.

Although the code called for preliminary measurements for the obtaining of the reduction factor only, it was thought best to make electrical measurements as well, that the efficiencies of the lamps might be obtained in watts per spherical candle and comparisons instituted between the different lamps under test.

Photometric Measurements.

The measurements of the spherical illuminating power of the lamps were made with the object of obtaining the average candle-power of the lamps, and to avoid the doubt as to the total amount of light which might arise from the various forms of carbon (many of them distorted in manufacture), used by different makers.

Sixty-five measurements or more were made on each lamp. The method pursued may be the more easily understood by a comparison with the parallels and meridians of the earth; referring to points by their latitude and longitude.

The lamp was placed in a vertical position with the plane of the shanks of the carbon at right angles to the photometer bar. The side nearest the bar was marked for future reference. The top and bottom of the lamp were assumed as the north and south poles respectively, and the vertical circle at right angles to the plane of the shanks of the carbon as the prime meridian. The lamp, after adjustment as above, was first rotated horizontally, and thirteen measurements were made in the equator at equal angles of thirty degrees, the last checking on the first. The mean of these measurements gave the "mean horizontal intensity."

Starting again from the first position, the lamp was rotated in the plane of the prime meridian and thirteen measurements were made at equal intervals of thirty degrees, the last checking the first, and making four measurements of the point 0° latitude, 0° longitude. The mean of these four was called the "standard reading." If any noticeable discrepancy was noticed the measurements at this point were repeated. As this point was that on which the calculations for the duration test were based, its careful determination was essential.

The lamp was then moved 45° horizontally, so that 0° latitude, 45° longitude E. was towards the photometer. It was then rotated in the vertical plane passing through that point and thirteen measurements made as before, at intervals of thirty degrees, the last checking the first.

The lamp was next moved 45° horizontally, so that 0° latitude, and 90° longitude E. was towards the photometer, and thirteen measurements made in that meridian as before.

Lastly, the lamp was rotated till 0° latitude, 135° longitude E. was towards the photometer and twelve, thirty degree measurements made in that meridian, checking with a thirteenth.

This makes a total of sixty-five measurements on each lamp. As the sockets in use with all the lamps prevented the exit of any light from the bottom or south pole of the lamp, the reading at that point was always taken as zero.

The measurements were combined as follows :—

The mean of four readings at the north pole of lamp	1
Four measurements on each of the parallels of 60° N. and 60° S. on the prime meridian and 90° meridian circle	8
Eight measurements on each of the parallels of 30° N. and 30° S. at the intersection of the meridian circles of 0°, 45°, 90° and 135°	16
Twelve measurements, 30° apart, on the equator	12
One zero reading for south pole (base of lamp)	1
Making a total of	38

By laying down the points on a sphere it will be found that they are very nearly equidistant, being somewhat nearer at the equator than at the poles.

The average of the illuminating power at these thirty-eight points is taken at the mean spherical intensity of illuminating power.

Fig. 1.

Points Observed in Determination of Spherical Intensity

Fig. 1 shows the location of the thirty-eight points. It is a photograph of a Mueller lamp of nearly spherical shape, around which four rubber bands are stretched to show the four meridian circles, and one rubber band to represent the equator. The square black patches show the thirty-eight points.

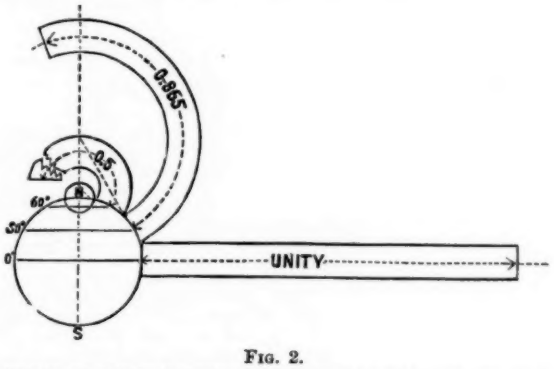


Fig. 2.

(This figure is defective in showing the chords instead of the tangents of the arcs.)

In order to determine whether the arithmetical mean of these observations gives a close approximation to the mean spherical intensity, calculable from the observations taken, the sphere may be divided into zones, each extending 15° on either side of the equator and the parallels of 30° and 60°, and the spherical intensity be calculated from the area of these zones and the mean candle-power in each (See fig. 2).

The surface of the sphere is developed at the equator by means of a tangent cylinder, at 30° and 60° latitude by means of tangent conical frustra, and at the poles by tangent discs.

FIG. 3.—REVOLVING LAMP HOLDER.

If now we multiply the mean intensity of illumination of each zone by its area, and divide the sum of these products by the whole area of the sphere we obtain with very close accuracy the mean spherical intensity of illumination

The following formula gives the method :—

$$\frac{\text{Mean eq. + mean } 60° \text{ lat. + } 1{\cdot}73 \text{ mean } 30° \text{ lat. + } 0{\cdot}131 \text{ poles}}{3{\cdot}861} =$$

mean spherical candle-power.

This method, when compared with that in use, gives—

Stanley (large) No. 26...13·09 candles. Method in use 13·10 candles.
Edison No. 2.....14·30 „ „ „ 14·38 „

The method adopted yields results giving slight preponderance to the illumination at the equator, but the difference is small, and this method yields itself readily to the mechanical conditions of the lamp holder. From the figure it will be seen that the holder permitted the lamp to be revolved about two axes at right angles in space.

(To be continued.)

THE TELEGRAPH CONFERENCE.

THE sittings of the commission for tariffs and administrative rules on Thursday, Friday, and Saturday of last week, gave rise to much discussion on subjects of considerable importance.

On Saturday the commission decided that no official code should be drawn up, but that the present rule which permits the use of any word to be found in standard dictionaries of the eight admitted languages, with its legitimate inflections, should be retained; also that the rule allowing 15 letters in a code word for European messages should be abolished and the number of letters reduced to 10, but that, as in extra-European code messages, the words might be taken out of any or all of the eight languages instead of, as at present, out of one language only. Further, that the return of charges for rectifying errors in plain or code language in unregistered European messages should no longer be allowed, but that as regarded extra-European telegrams each State should be at liberty to refund such money if it desired to.

These decisions, which will most probably be confirmed in the full conference, may be considered satisfactory to the British public, seeing that for the most part they maintain the present regulations, and in the case of code messages allow one system of code to be used all over the world. There appears to be no doubt that the rates between England and Russia and Spain and some other countries will be reduced, and also the rates between England and India and Australia—in the case of India probably by 7d. per word, and in that of Australia by about 2s. 6d.

On the evening of the 7th inst., an entertainment was given by the Municipality of Berlin which was a mixture of a *conversazione*, a classical concert, a theatrical performance, and a supper.

The dramatic part of the entertainment consisted in an allegory entitled "Electra," specially written for the occasion by Herr von Wildenbruch. The *dramatis personæ* of the piece were Mother Nature, Man (Der Mensch), Electra, the Demon of Gunpowder (a most terrific sprite), and Peace, a white-robed and palm-branch bearing youth, crowned with a coronet of electric lamps—and all these parts were played by histrionic "stars" from the Schauspielhaus.

The Berlin correspondent of the *Times* communicates the following interesting rules with respect to a prospective system of international telephony, which have been approved in committee, and will in all probability be accepted by the full conference :—

"1. The administrations of the contracting States may establish, as required, international telephonic communication, either by laying special wires, or by devoting to this service wires already existing.

"2. In default of special arrangements between the said administrations, these wires shall be conducted into a central telephonic office of each, and thence connected either with the telephonic offices provided for public use, or with private houses, offices, workshops, &c.

"3. The administrations shall agree upon the choice of materials, and the details of the service. They shall fix in common the rate to be paid for each telephonic line.

"4. The unit adopted for the collection of rates and duration of communication is a conversation of five minutes' length.

"5. The use of the telephone shall be allotted in the order of applications. The same correspondents shall not be allowed more than two consecutive conversations of five minutes each, except when no other application shall be made, before or during those conversations."

The following rules with respect to money orders have also been approved in committee :—

"1. Post Office orders may be sent by telegraph between offices which agree to adopt that mode of transmission. They are then to be called telegraphic orders.

"2. Telegraphic orders are to be charged for and treated as ordinary private telegrams. They may, on the same conditions as apply to the latter, be submitted to the formalities of urgency, repetition, acknowledgment, and delivery by post or messenger. Besides the prescribed portion hereinafter mentioned, they may contain a private message from the sender to the receiver.

"3. Telegraphic orders are to be addressed by the office which has received the money and address to the office which has to pay them.

"4. Partial repetition is to be obligatory (namely, of names and amounts).

"5. The office receiving orders shall take such measures as may seem advisable for delivery of the order to the person entitled to it, and for the collection of the cost of carriage beyond the lines."

It is expected that the Conference will be able to dispose of all its work in a day or two and to separate next week. Several representatives of private companies have already left.

In Tuesday's sitting of the Tariff Committee the representative of Brazil submitted a proposal to reduce the transit rates over the Brazilian land lines by 25 per cent., coupling this offer, however, with a stipulation that in consideration of such reduction the State lines in Brazil should be considered the cheapest route, and consequently that all European States should agree not to forward messages for Brazil and South America without designating the route. On behalf of the cable administration it was shown that inasmuch as a reduction on the Brazilian land lines would necessitate a similar lowering of tariff by the cable company the request of Brazil was inadmissible, as with equal tariffs it would remain impossible for the European administration unduly to favour any particular route. The ultimate decision of the question was deferred, but the general sense of the Tariff Committee is against the proposal, the more so as it contravenes the existing rules of the Convention. A settlement of existing differences between the telegraph administration of the Government of Brazil and the cable companies, which seem to have good reason to complain of the treatment which they have received, would appear to be very desirable; but of course these private questions are beyond the province of the Conference. On Wednesday the members of the Conference did not assemble.

AN INSTRUMENT FOR MEASURING FORCE.

RECENTLY, while making some measurements of "force," I experienced the necessity of an appliance that would increase or decrease the "pull" it exerted smoothly and regularly. To attain this end I devised the instrument illustrated in the accompanying drawing.

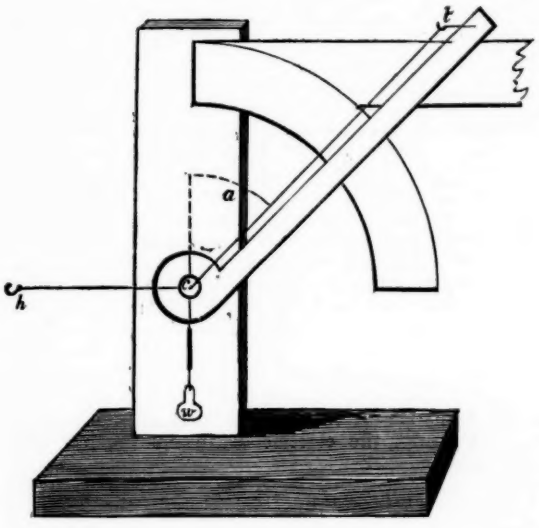
The arm, t, c, turns about the centre, c, and can be held in any position by the friction of the pivot at c. The three threads, t, c, h, c, and w, c, are joined at c, the length of t, c, being so adjusted that the joint of the three threads is opposite the pivot of the arm, t, c. Then, when a weight is suspended at w, the force with which the thread, h, c, must be held, in order that the junction of the three threads may remain opposite the point, c, is given by the formula

$$f = w \tan. a,$$

where a is the angle formed by the thread, t, c, with

the perpendicular; the tangent, a, may be either measured from the tangent scale, or obtained from the quadrant in front of which the arm, t, c, moves.

By using different weights at w, and by using stronger threads to measure large forces, or finer



threads to measure small forces, the range through which this instrument will measure may be made very great. Thus, by using $\frac{1}{16}$ oz. with cocoon silk, and 1 oz. with cotton, and 1 lb. weight with twine, the instrument will measure forces ranging from $\frac{1}{3000}$ lb. to 2 lbs. with an accuracy of $\frac{1}{30}$ to $\frac{1}{100}$ part.

W. MOON.

REVIEW.

Apuntes para un Proyecte de Fábrica de Eléctricidad en Cadiz. (Notes on the Project of an Electrical Manufactory at Cadiz.) Par FRANCISCO DE LA VIESCA. Cadiz: F. de P. Jordan.

The author of this pamphlet discusses in his introduction the line of conduct which the friends of the electric light ought to observe with reference to the Cadiz Co-operative Gas Company.

In the first part he enters upon the history of gas lighting, and like French authorities he gives the credit of the original invention to Lebon, whose experiments he carries back to 1775 or 1776. It must be remembered, however, that Lebon made no communication to the Institute until 1799; that he only took out his patent in 1800, and that the memoir in which he described his process appeared only in 1801. Moreover, there is no evidence that he ever experimented with coal gas at all. On the other hand Murdoch, the Scottish inventor, lighted up his dwelling and offices at Redruth with coal gas as early as 1792, and in 1798 fitted up a gas works at the manufactory of Bolton and Watt, at Soho. Hence we must protest against the priority claimed for Lebon.

The author having then given a sketch of the history of the electric light, points out its advantages as compared with gas.

He then goes on to discuss the proposed establishment for generating electrical energy, for transmission of power, and for lighting. Finally he examines the rival projects, and compares the respective cost of the electric light and of gas. His calculations show that under the circumstances which prevail at Cadiz there is a slight pecuniary advantage in favour of the electric light, not to speak of its superiority in other respects. Of course at Cadiz coal is dearer than in England.

NOTES.

Electric Lighting and Gas.—Some curious facts cropped up during the debates at the Convention of the National Electric Light Association in New York, among them being the assertion that the entrance of an electric lighting company into a district where gas is used invariably increases the business of the gas company.

The Gülcher Light at the Alexandra Palace.—According to the statements made at the public examination of Messrs. Levey and Ray, of the Alexandra Palace, last week, the installation of the electric light at the Palace has not been an unqualified success. Mr. Ray, in the course of his examination, said there had been a failure of the Gülcher light system on several occasions, and there was a law suit pending for damages with the company. He considered that a very great loss had been suffered by them in consequence of the failure of the light. On the Good Friday night the Palace was in total darkness for several minutes until the gas could be lighted, in consequence of the failure of the light. The public examination of the bankrupts was ordered to be concluded.

Telephonic.—Workmen are busily engaged erecting wires in Carlisle for the telephone exchange, which is about to be opened in the border capital. About thirty private firms and gentlemen have contracted for lines, and the Town Council are to have their principal offices connected with the exchange.

Telegraphs in Corea.—It is stated that various lines of telegraphs are to be constructed in Corea under the superintendence of Chinese officials. The preliminary surveys have already been commenced between Gensan and Seoul, and at various points on the Chino-Corean frontier. The length of the lines actually undertaken is over 400 miles.

The British Association.—The 55th annual meeting of this association was opened on Wednesday, under the Presidency of Sir Lyon Playfair. At the general committee meeting held early in the day, the report of the council for the year was read, Mr. A. T. Atchison being nominated to succeed Professor Bonney, the retiring secretary. One of the resolutions referred by the general committee to the council for consideration, and action if desirable, is as follows:—That the council be requested to examine the feasibility of instituting a scheme for promoting an international scientific congress, to meet at intervals in different countries, and to report thereon to the general committee at the next meeting of the association."

Rear-Admiral Bedford Pim also moved the following resolution:—" That the British Association, learning that the American Association for the Advancement of Science contemplate holding their meeting in London in 1887 or 1888, hereby tender their sister association a most hearty welcome." The consideration of the subject was deferred to Monday's meeting.

At 8 o'clock a crowded and brilliant audience assembled in the music hall, which conveniently accommodates 2,500 people, and, long before the proceedings began, every seat was occupied. Lord Rayleigh, after delivering a few well-chosen words, then vacated the position which he so worthily occupied at the Montreal meeting of the Association, in favour of the incoming President, who delivered his opening address, which will be found in a condensed form in our other columns. It seems doubtful, however, whether the address will meet with universal approval, for although eminently practical, it was neither popular nor scientific. Notwithstanding the great efforts made in the direction of scientific education by continental countries less wealthy than our own, we have every reason to feel satisfied with the place occupied by England in the domain of science.

An Electric Log.—The Indian troopship *Crocodile* made a two-hours' full-power trial of her machinery on Wednesday morning. During the run Mr. Brunel made a trial of a new electric log for determining the speed of the ship at any given moment. It worked very well for some time, but was eventually carried away by the strain thrown upon the electric connections.

Fatal Quarrel.—Massachusetts papers give full reports of the murder of Mr. A. D. Swan, an old subscriber to the ELECTRICAL REVIEW, by Mr. H. K. Goodwin, of Lawrence. The parties had quarrelled over a telephone patent, and Goodwin shot Swan with a revolver, in a manner which afforded the fullest evidence of premeditation; but he will rest his defence on the plea of insanity. His counsel will probably make the fullest use of the fact that immediately after committing the murder the criminal "walked to the telephone and called to the police station for an officer to come and arrest him."

The Inventions Exhibition.—On Friday evening in connection with the Balloon Society a lecture, followed by a discussion, on "The Inventions Exhibition: its Merits and Demerits," was delivered in the lecture-room of the Royal Aquarium, Westminster, by Mr. Thomas Moy, C.E. The lecturer, in opening his subject, said that to the late Mr. John Scott Russell was principally due the inauguration of the Great Exhibition of 1851, which, as was well known, was a great success, and upon the same lines subsequent exhibitions had been carried out. The managers of the Inventions Exhibition had to be congratulated on the monetary success attained. The number of visitors had been something astonishing, but the scenery and other attractions had been the chief means of success, and Old London had its many admirers, but the exhibition ought to have been carried out in a more liberal spirit towards exhibitors of inventions. They had space free of cost, but large firms were granted extensive space for mere advertising, while inventors were often put off with curtailed allotment, or left out altogether. For himself he applied for a space, and was refused. Thus inventions were crowded out by mere advertising shows in which there was not even any novelty. He considered that the demerits were in the building arrangements, and that for an exhibition of this character the arrangements should radiate from a centre from which visitors could select any part of the exhibition they wished to visit—the lighter and finer goods being placed near the centre, and the heavier goods towards the outer circle. Again, he considered there was a want of judgment in granting space. There was too much of the same kind of article which in many instances could not claim to be an invention. Meanwhile the poor inventor was snuffed out. He again objected to the system of awards—a bit of metal called a medal. In the first exhibition it was all very well; but he suggested that a few substantial prizes for real serviceable inventions should be given; for instance, £5,000 for such an improvement in the construction of the steam engine as would reduce the consumption of fuel to one pound of coal per horse per hour. Mr. Archilly expressed his approval of all that the lecturer had advanced, and his conviction that the managers of the Inventions Exhibition had gone on wrong lines. He moved, "That in the opinion of this meeting the jury commissions, judged by the awards made, have not been guided by the spirit of the prospectus as issued by the executive council, in that the interests of bonâ fide inventors have not met with due consideration at the hands of the various juries; and that it is due to the exhibitors that close inquiry should be made, and that copies of this resolution should be sent to the Prince of Wales and Sir Frederick Bramwell." This was seconded by Mr. Jellaby, who said he had been most unfortunate in the treatment he had received, and the resolution was passed by a large majority.

The Edison-Swan Lamp.—The Edison and Swan United Electric Light Company, Limited, notifies that arrangements are now in progress for the removal of the company's lamp factory from Newcastle-on-Tyne to a new and extensive factory at Ponder's End, in the neighbourhood of London. This step has been necessitated by the large increase of the company's business. Of the 15,558 incandescent lamps lighted at night at the International Inventions Exhibition, as shown by the official catalogue, the company has supplied 12,298; in addition to 3,310 lamps in the "Swan" and "Edison and Swan" stalls, so that there are altogether 15,608 of this company's incandescent lamps at the Inventions Exhibition. This number, when compared with the exhibit of 1,200 lamps by the Edison and Swan Companies at the Crystal Palace Exhibition in 1882, serves as a fair indication of the very real progress of incandescent electric lighting during the past three years. The following official returns from the Admiralty and the Courts of Justice serve to show the steady improvement that has been made in the actual manufacture of the Edison and Swan lamps:—The average life of the lamps on H.M.S. *Malabar*, as stated by Mr. Farquharson before the Institution of Civil Engineers, was 3,799 hours. The average life of the lamps at the Royal Courts of Justice up to a recent date, as registered by Mr. A. Grundy, the electrician in charge, has been 1,631 hours.

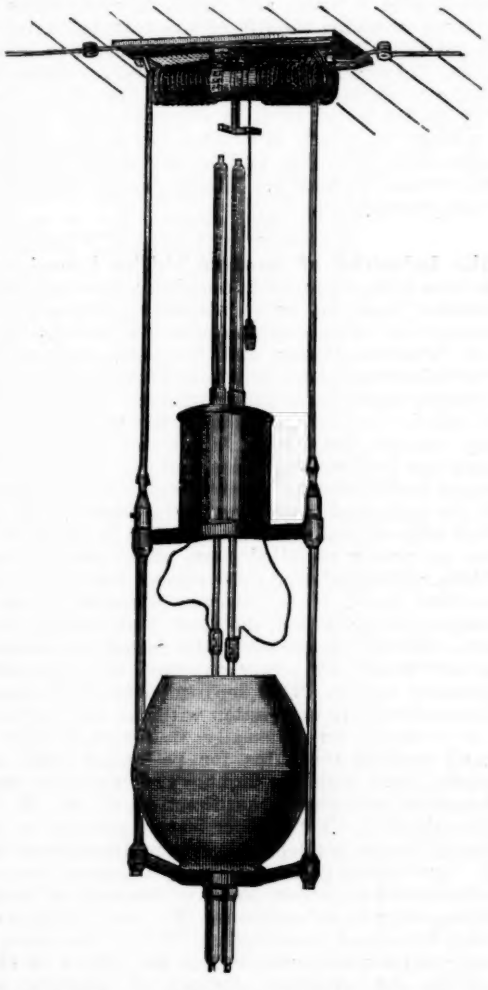
Lighthouse Illuminants.—Writing to the *Times* of Saturday last on the subject of the recent lighthouse experiments, Mr. John R. Wigham says:—"But deeply important as this question of the comparison of gas and oil may be, a main object of the inquiry was to ascertain whether either or both of these lights were superior or inferior to the electric lights in foggy weather. On this part of the question the Trinity House, as you say, have given 'their verdict with no uncertain sound,' but their own report shows that they have very insufficient *data* for their conclusions, and when I find by the report and otherwise that in the trials with the electric light the beam was so manipulated as to be focussed directly upon the observers, and not, as is the case in all lighthouse lights, upon the horizon and the intervening space, you will see that the recorded observations are absolutely worthless, and that we are as far from the solution of the question as to the best light for lighthouses as before the inquiry commenced. An error so fatal having vitiated the experiments it is evident that in order that the public mind may be satisfied, a new set of experiments should be made under the express condition that all the lights under trial should in every instance be focussed upon the horizon, so that the observers may see them under the same conditions—in other words, should be all lighthouse lights, visible at the horizon, and, at the same time, at all points between the horizon and the lighthouse. What such a set of experiments might reveal it is not for me to predict, but they would not, at any rate, be open to the charge of unfairness, and I think that this further investigation is the more demanded because of the interesting fact that both the gas and oil lights exhibited at the South Foreland experiments completely outshone even in clear weather the two highly reputed permanent South Foreland electric lights with which travellers crossing the Straits of Dover are so familiar."

The report of the Committee on Lighthouse Illuminants, of which we have already published an account, was issued on Saturday last as a Parliamentary Blue-book.

Lord Randolph Churchill and the Electric Light.—The author of "Society in London," after remarking that Lord Randolph Churchill's love of display and magnificence is only tempered by the perfect taste of Lady Randolph Churchill and himself, concludes his notice of the famous politician in the following apposite terms:—"Everything in the Randolph Churchill establishment is *comme il faut*. His house is one of the few that possesses the electric light."

Cable Companies' Competition.—A Glasgow contemporary says:—The opposition between the various foreign telegraph companies is daily becoming stronger. Some time ago the Eastern Company opened an office in this city, and rented a wire from the Post Office to their offices in Liverpool and London. This was soon followed up by the Bennett-Mackay "Commercial" Company opening an office with direct communication to their Liverpool office, and now the Anglo-American Company have found it impossible to compete with the other companies, and have consequently opened an office with direct connection to their English stations also. With these conveniences business men can communicate with their agents in America or elsewhere with almost as little delay as with their London agents, and a message was shown to me the other day, which was a reply to a message sent to New York, the reply having been delivered in little over an hour. The opposition is causing the rates to be much reduced, and, to keep in the market, each company is doing its utmost to secure the patronage of our American traders.

Arc Lamp Suspender.—The apparatus illustrated below is used by the Western Electric Company for raising and lowering arc lamps. The inventor is Mr. John Young, a gentleman connected with the electric lighting department of the Western Electric Company. It consists of a drum, smaller in the centre, where the



cord for raising and lowering the lamp is wound; at the ends of the drum the conducting cables are wound. By means of the cord and the pawl and ratchet device operated by it the lamp may be raised or lowered or held in any desired position. The device, says our New York namesake, is an excellent one, and is meeting with favour wherever put in use.

Electricity and Dust.—With regard to the experiments made by Prof. O. J. Lodge, it has been pointed out by a German paper that a similar experiment was described by C. F. Guitard, of London, in the *Mechanics' Magazine* for November 2nd, 1850. The following is an extract:—"Some time since, in experimentalising on the electric state of the atmosphere, I employed for that purpose a large glass cylinder, about 18 in. high and 9 in. diameter, open at bottom and having a neck at top. In placing the lower end of this cylinder in water, the more perfectly to exclude the air, and allowing small quantities of tobacco smoke to enter the neck at top, the smoke, after assuming various actions, according to, probably, the hygrometric state of the atmosphere, would gradually spread itself into a cloud filling the cylinder, and at length, as successive portions came in contact with the sides of the cylinder, condense. Sometimes half-an-hour would elapse before this effect took place. It now struck me that if I brought a wire from an electrifying machine into the neck of the cylinder, the air would immediately become charged with electricity, which would cause each portion of the smoke to fly to the sides of the cylinder, and that thus more rapid condensation would take place. The effect produced was perfectly magical. The slightest turn of a small electrifying machine produced immediate condensation. It was astonishing to see how small a quantity of electricity produced a most powerful effect. I am not aware that attention has ever been drawn to this subject; and the question will probably arise—Has electricity anything to do with the condensation of steam in the condenser?"

University College, Bristol.—The next session of the college will begin on 6th October. Lectures and classes are held every day and evening throughout the session. In the chemical department there are lectures and classes in all branches of theoretical chemistry, and instruction in practical chemistry is given daily in the chemical laboratory. Excursions to some of the mines, manufactories and chemical works of the neighbourhood are occasionally made. The department of experimental physics includes various courses of lectures arranged progressively, and practical instruction is given in the physical and electrical laboratory. The department of engineering and the constructive professions is designed to afford a thorough scientific education to students intending to become engineers, or to enter any of the allied professions, and to supplement the ordinary professional training by systematic technical teaching. This department includes courses specially arranged for students intending to become civil, mechanical, or electrical engineers, surveyors or architects. Several scholarships are tenable at the college.

A New Calculating Machine.—In an article giving some particulars of a machine to lighten the labour of computation, published in the *Financial News* of the 9th inst., it is stated that there is at work in the Massachusetts census office a little machine, the device of Charles F. Pidgin, chief clerk of the State Bureau of Statistics, which bids fair to do even more to lighten the labour of computation than the type-writer has done for pencraft. It is literally a "lightning calculator," electricity being the motive power. Over 130 calculating instruments have been in use at various times, but this is said to be the first operated by electricity, without cogs, capable of entering any digit by one motion, that "carries" automatically up to any number of places, and that can also have any dial set back by hand independent of the motor.

Sale of Engineering Plant.—Messrs. Wheatley Kirk, Price & Goulty, announce the sale on Tuesday next, at 11 o'clock, of the entire contents of the South Hants Engineering Works. The sale will take place on the premises at Portsmouth, and the plant will be on view from the day previous till the time appointed for the auction.

The Light of the Future in Trouble.—At Marlborough Street last week George Johnson was summoned by the Commissioners of Police for unlawfully carrying an advertising lantern, illuminated by electricity. Police-constable Galloway said that he saw the defendant and three other men, each carrying a lantern on a pole, and on which, by way of advertisement, were the words "The Prince's Theatre." In answer to Mr. St. John Wontner, who appeared for the defence, the constable said that he had cautioned the men, as he considered the lanterns were likely to frighten horses in the roadway. Mr. Wontner said there was no proof that the Commissioners of Police had disapproved of this mode of advertising a theatre. Mr. Edgar Bruce, who employed the men, had no idea that he was offending the law. Directly that he became aware of the fact, he withdrew the men and the lanterns from the streets. Mr. Wontner suggested that the summons should be postponed, in order that the Commissioners might be consulted in the matter. As to the electric light frightening horses in the streets, he might observe that, as it was sure to be the light of the future, the sooner that horses became accustomed to it the better. Mr. Mansfield said that the defendant had clearly offended against the police regulations, and he had no alternative but to inflict a fine. Under the circumstances, however, it would be merely nominal.

Mr. Edgar Bruce, writing to the *Morning Post*, under date September 7th, says :—May I ask you to kindly state the following facts respecting the balloons which apparently have so offended the police? They are constructed of a light wire framework covered in silk, and measure 45 inches in circumference, and the light inside is equal only to five candle-power, and this is considerably reduced by the colour of the silk, an ordinary pink. The balloons were carried, by the aid of canes, at the height of 10 feet above the pavement, and yet the witnessing constable objected to these dim and elevated lights, his reason being that they frightened horses. By the magistrate's decision it is evident that the police have power to forbid or allow these balloons to be carried in the streets. I am, therefore, petitioning the Commissioners for the necessary permission, which, I am convinced, will be granted to me when the harmless nature of the instrument is shown to them.

Inventions for Disposal.—The following inventions were advertised for disposal in last week's *Inventors Mart*:—

Electric Bell.—By this method a bell of any size can be sounded in repeated strokes by means of a single-cell battery. Model to be seen. Want Manufacturer to take up on royalty.

Electric Fire Alarm.—This is an auxiliary to the ordinary bell push, with the use of which it does not in any way interfere. When the temperature exceeds a certain determined temperature, the bell is rung. Very simple and cheap.

Electric Signal.—Purely automatic. Is on the block system. Wants money to develop.

Small Portable Battery.—Will run medical lamp of two candle-power for 20 minutes, and again after an hour's rest. It is dry, and does not want renewing. Patent for sale.

The following is also wanted: "Something new in incandescent lamps that will be suitable for theatres."

The New York Underground Wire Commission.—The Commissioners have resolved to advertise for electricians to submit plans for the construction of electrical highways. The Commission is authorised in certain cases to deviate from the underground system, the following being among the excepting clauses: "Whenever in the suburbs or along the streets, avenues or other highways in sparsely inhabited or unoccupied portions of this city the public interests do not require the electrical conductors to be placed underground;" and the board has resolved not to entertain any applications for permits to deviate from the underground system that are not based upon the grounds of exception stated.

Thereby Hangs a "Tail."—Mr. Richard A. Proctor, the conductor of *Knowledge*, writes in that excellent periodical (which is shortly to be issued as a sixpenny monthly magazine) as follows:—"Professor Stokes, in his lectures on light, inclines to the belief that Sir F. Herschel's suggestion may be correct, according to which the development of a comet's tail is due to electric repulsion; and Prof. Stokes suggests, on his own part, that the repulsion may be due to an electric charge on the sun, resulting from the process of condensation in the inert particles of the comet's head, I wonder whether any direct evidence showing that either suggestion is sound will ever be obtained. Prof. Tait, of Edinburgh, commenting on Prof. Stokes's ideas, expresses his still lively love for the 'swarm of cosmical brickbats' theory, which he mistakenly imagines to have been suggested by astronomers in explanation of comets' *tails*. In reality, no astronomer ever supposed the cosmical brickbats (that is only Prof. Tait's funny way of saying meteors) had anything to do with comets' tails, near which they have never been seen."

A Noble Deed.—An interesting ceremony was witnessed last Friday morning at Dover, at the parade of the Royal Irish Rifles before their departure for Ireland. Colonel Lloyd, the Commandant, presented James M'Cudden, a Dover telegraph clerk, whose gallant conduct formed the subject of one of our notes last week, with a watch and chain, in recognition of his bravery in saving the life of two men belonging to the Royal Irish Rifles. Calling the regiment to attention, the Colonel said it was with great pleasure he made the presentation on behalf of the officers and men of the 3rd Royal Irish in recognition of the gallant manner in which M'Cudden saved two of their comrades from drowning, and he hoped the recipient might live long to wear it. Hearty cheers were given after the presentation.

"The Industries of Scotland."—The following is taken from a large pamphlet, entitled, "The Industries of Scotland," and may prove interesting to our readers:—Amongst the exceptional features of the workshop of Messrs. William Denny and Brothers, Dumbarton, there is a department for the electric light, not only for the lighting of the yard, but also for the equipment of ships built by the firm. Lighting the yard there are twenty Brockie arc lamps, driven by two sets of engines, two Gramme machines, and one exciter. For the small dock a separate plant is laid down, consisting of six arc lights and two "Phœnix" dynamos. At the present time the electric engineering department is driven by power supplied from these engines and machines, and transferred by overhead wires to a distance of 300 yards. It is, however, intended to have a central generating station, the floor of which is to be of cement, and the machines to be raised on concrete piers, and driven by power supplied by a powerful independent engine. This department is now in course of construction. In connection with the electric lighting, as a whole, an unusually well-stocked store is kept, as now all the ships for passenger traffic are invariably fitted with the light. The whole of these arrangements are under the direction of Mr. R. D. Smillie, M.S.T.E. Yet another feature peculiar to the works is a complete telephonic system throughout the yard. In a central position there is a general station, and distributed at various points of the yard and shops are thirty other or sub-stations. To each manager or foreman belongs a certain flag. When, therefore, a manager or foreman is required at the offices or elsewhere on the premises, instead of sending out messengers to find him, the central station is called up, and the particular flag hoisted; the required man either sees it or is informed that his flag is flying, and he proceeds to the nearest station and learns what is needed. This arrangement works remarkably well, and effects a great saving of time in search of a manager.

The Edison Light.—During the week of the Electric Light Convention the general agents of the Edison Company were in New York conferring with the parent company. and receiving and giving points on future business.

Underground Wires in New York.—Mr. Edward S. Stokes, who, as we recently announced, has purchased the Bankers and Merchants Telegraph Company, has intimated that the company is willing to put its wires under ground, and will submit plans. Several other companies have submitted plans for subways, and one electrician has asserted that all the wires in the City could be put under ground for one and a half million dollars.

Photographing a Pistol Shot.—A Prague professor of an inquiring mind has made some remarkable photographs of a pistol bullet in its flight, under the illumination of an electric spark.

Journalistic Enterprise.—Our contemporary and namesake in New York claims to have outshone its rivals in connection with the recent Electric Light Convention, as it was enterprising enough to engage a stenographer in addition to being represented by three, and sometimes four members of its staff. A whole suite of apartments was taken by the *Review* in the Hotel Dam for the use of its editorial staff, and for the convenience and entertainment of the members of the Convention.

Adie's Steel-Tooth Belting.—We find that our reporter in noticing this new departure in the machinery world has inadvertently and by misapprehension made the mistake of putting Mr. James H. McKean in a false position when he states that that gentleman is representing the makers. All that Mr. McKean had or has to do with the belting he has already done, viz., he succeeded, under difficult circumstances, in getting Messrs. Dick, Kerr & Co. to allow an experiment to be made in their exhibit. We are given to understand by the commercial manager of this department of Mr. Adie's manufactures that the invention is now undergoing further development, and will not be put on the market for some ten days yet.

Engineering Scholarship.—The Gilchrist (Entrance) Engineering Scholarship at University College, London, is open for public competition on the 28th of September and following days. The scholarship is of the value of £35 per annum, for two years, and candidates must be under 19 years of age on 1st of October. The subjects are mathematics, mechanical drawing, use of tools, &c. —several of them being optional. Full particulars can be obtained on application to the Secretary of the College, Gower Street, W.C.

In the Distance.—The King of Sweden has informed the Academy of Sciences at Paris that upon attaining his 60th year in January, 1889, he intends offering a prize of 2,500 fr., in addition to a gold medal, valued at 1,000 fr., to the author of the most important discovery in mathematical science. The judges, who have already been nominated, consist of three gentlemen, the first being a Swiss, the second a German, and the third M. Hermite, a member of the Paris Academy of Sciences.

The Distribution of Electricity.—Dr. Hopkinson has done well in calling attention to a danger (see our other columns) which has hitherto passed unnoticed, existing in certain apparatus which have recently been the objects of serious consideration in the problem of electrical distribution.

Electrical Appointment.—The Blackpool Electric Tramway Company has recently appointed Mr. Arthur Hoare to the post of electrician. Mr. Hoare obtained his electrical knowledge in the School of Electrical Engineering in Prince's Street, Hanover Square, gaining the certificate of the school with great credit at the termination of his course, the examination for which is severe, and conducted by examiners unconnected with the teaching staff. Mr. Hoare was in charge of an experimental electric railway at the Winter Garden, Blackpool, during the latter part of 1884.

Incandescent Lamps.—We publish this week a portion of the Report of the Franklin Institute on the Efficiency and Duration of Incandescent Lamps, but as there are so many tabulated results which we cannot undertake to reproduce, we would advise those of our readers who are interested in the Report to procure the September number of the Institute Journal.

NEW COMPANIES REGISTERED.

Universal Telephone Company, Limited.—Capital: £400,000 in £1 shares. Objects: To acquire and work the British, Foreign, and Colonial patents of M. Kazimir Stanislas Dembinski, of Brussels, relating to improvements in microphones and electrical apparatus for the transmission and reproduction of sound. Signatories (with one share each): E. Brailsford Bright, C.E., 31, Golden Square; J. Brailsford Bright, Inner Temple; Col. J. B. Malleson, 27, West Cromwell Road; C. Barker, 32, Fenchurch Street; W. J. Steele, Annandale Lodge, Blackheath; Colonel R. F. Webb, 6, West Cromwell Road; J. J. Fleming, 198, Elderfield Road, Clapton. Qualification for directors (other than the first): 20 shares. The signatories are to nominate the first directors. Remuneration: £1,500 per annum, and in addition thereto £5 per cent. of the net profits remaining after payment of 10 per cent. per annum dividend. M. Dembinski is appointed electrician to the company. Registered 4th inst. by Messrs. W. H. Smith and Son, Gresham House.

New Electro Amalgamator Company, Limited.—Capital: £6,000 in £1 shares. Objects: To acquire the assets and contracts of the Electro Amalgamator Company, Limited. Signatories (with one share each): P. Jerome, 14, Great Titchfield Street; W. Dicks, 84, Ashbury Road, Lavender Hill; C. Jones, 9, Tokenhouse Yard, E.C.; D. T. Roper, 20, Sudbourne Road, S.W.; W. M. H. Young, Radlett, Herts; A. W. Boon, 10, Warner Road, Camberwell; J. F. Marshall, Kent Cottage, Kington. The first directors are Captain F. Howlett, 8, Colville Terrace, W.; Wm. Strapp, Redhill; and Septimus Short, of Sheffield. Registered 9th inst. by T. B. Maddison & Co., 4, Tokenhouse Buildings.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES

Manchester and District Edison Electric Light Company, Limited.—The annual return of this company, made up to the 31st ult., was filed on the 9th inst. The nominal capital is £600,000, in 50,000 "A" and 10,000 "B" shares of £10 each. 20,000 "A" and 10,000 "B" shares have been taken up, and upon the former £2 per share has been called up, and the full amount upon the latter. The calls paid amount to £140,000.

CITY NOTES.

The South-Eastern (Brush) Electric Light and Power Company, Limited.—The creditors of this Company are required, on or before the 22nd inst., to send their names and addresses, and the particulars of their debts or claims, to William Henry Pannell, the liquidator of the company, at the registered office of the company, 38, Basinghall Street, or in default they will be excluded from the benefit of any distribution of the assets of the company.

The Devon and Cornwall Electric Light and Power Company.—A return of 5s. per share is announced by the liquidator of this company.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September 4th were £2,254, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for August, 1885, amounted to £41,987, and to £39,465 for the corresponding period of 1884, an increase of £2,524.

The Great Northern Telegraph Company. The receipts for August, 1885, £24,000; from January to August, 1885, £192,040; for the corresponding months of 1884, £182,680; and of 1883, £168,400.

The Eastern Telegraph Company. The receipts for August amounted to £47,968, and to £45,329 in the corresponding period of 1884.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended 4th September, amounted to £2,951.

NEW PATENTS—1885.

10333. "Construction of galvanic or voltaic batteries." A. SERRAILLIER, F. DUCHER. Dated September 1.

10335. "Electrical mechanism for forcing air to the flame of oil lamps or burners." J. H. ROSS, R. NOLAN, A. MACKENZIE. Dated September 1.

10341. "Store service apparatus." S. G. NORTH. Dated September 1. (*Complete.*)

10342. "Store service apparatus." I. BIRGE. Dated September 1. (*Complete.*)

10343. "Store service apparatus." I. BIRGE. Dated September 1. (*Complete.*)

10357. "Covering telegraphic and other wires with India rubber, &c." A. W. L. REDDIE. (Communicated by V. and J. Royle.) Dated September 1. (*Complete.*)

10370. "Electric telephony." J. G. LORRAIN. Dated September 1.

10373. "Electric lighting apparatus." W. R. LAKE. (Communicated by H. P. Brown.) Dated September 1. (*Complete.*)

10384. "Automatic electric fire alarm." A. DALZIEL. Dated September 2.

10433. "Electric tramways." F. H. DANCHELL. Dated September 3.

10448. "Electric ear telephone." E. SPAULDING. Dated September 3.

10449. "Telephone transmitters." C. A. TESKE. Dated September 3.

10450. "Telephonic system." C. A. TESKE. Dated September 3.

10453. "Lighting and extinguishing device for electric lamps." A. RADIQUET, E. PARENTHON. Dated September 3.

10455. "Electric generators." E. JONES, A. E. JONES. Dated September 3.

10463. "Electric current meter." H. S. S. WATKIN. Dated September 4.

10470. "Automatic contact breaker for anchored submarine mines or torpedoes." M. SELIG. Dated September 4. (*Complete.*)

10474. "Switch for electric lighting." W. D. HASSALL. Dated September 4.

10496. "Air pump for use in making electric lamps." W. R. LAKE. (Communicated by W. Wrady.) Dated September 4. (*Complete.*)

10518. "Conduits used in electric and wire rope railways and tramways." P. R. ALLEN. Dated September 5.

10529. "Facilitating the adjustment of electric lamps." T. T. SMITH. Dated September 5.

10538. "Gas burner with electric ignition." F. GIRAUD, E. NEE. Dated September 5.

10540. "Electric measuring instruments." J. G. SLATTER. Dated September 5.

10559. "Rotary electrical motor for hand use and other purposes." C. D. SALAZAR. Dated September 7.

10600. "Telephone repeaters." C. A. ALLISON. (Communicated by M. G. Farmer.) Dated September 8. (*Complete.*)

10606. "Curative voltaic batteries." R. M. KENNEDY. Dated September 8. (*Complete.*)

10646. "Armatures for electric generators and motors." H. H. LAKE. (Communicated by S. F. Van Choate.) Dated September 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

11244. "Improvements in dynamo-electric machines." G. FORBES. Dated August 13. 10d. Has for its object the improvement of dynamo-electric machines, and relates especially to machines such as are described in the specification of a former patent, number 3,115, granted in the year 1883. Each iron disc is replaced by a large number of thin discs or rings insulated from the spindle and from each other. These discs or rings may be clamped between two thicker insulated discs or rings revolving with them, and serving to solidify the armature by compressing the thin discs tightly. The two sets of thin discs, which replace the two discs of the former specification, are connected, the first thin disc of one set with the first thin disc of the other, by an insulated bar or connecting piece, and the second with the second, and so on. These bars or connections are within the rings, they lie along the axis. The outer peripheries of the rings are in electrical connection with collectors of any convenient form, they may be springs, mercury contacts or other; and the second disc of one set is electrically connected externally with the first of the second set by the collectors, and so also the third of the first set with the second of the second set, and so on. The first disc or ring of the first set and the last of the second set act as terminals. The rings may be of iron, and the bars of copper, or the rings of copper and bars of iron, or both may be of iron or other magnetic metal.

12060. "Electrical safety apparatus for lift cages." N. COWARD. Dated September 5. 6d. The inventor applies to the cage pivotted brake arms, which, as long as they retain a certain attitude, are free, but which acts as brakes when they become canted. The arms are held in the free attitude by a trigger worked by the armature of an electromagnet, as long as a current of electricity is maintained through the coil of the magnet. This electricity is conducted by insulated wires passing from a battery along or within the hauling rope or chain. When the rope or chain breaks, the electric conductors are at the same time severed, and the magnet then ceasing to attract its armature, the trigger is released, and the arms of the cage become canted so that they act as brakes, stopping movement of the cage. The rope or chain is connected to the cage through a clamp, which, in case of overwinding, is opened apart by encountering a wedge piece fixed at the top of the lift, and thus the cage is freed from the rope or chain, and, the electrical conductor being at the same time severed, the cage is stopped as above described.

12314. "Improved means for effecting the breaking, retarding, or stopping the progress of vehicles, and of rotating mechanisms, by the aid of electricity." A. RECKENZAUN. Dated September 12. 6d. The object of the invention is to utilise the momentum stored up or accumulated in a travelling vehicle, or in a motor, or other mechanism, as a means of retarding or stopping motion. The invention is especially applicable in cases where electromotors are employed to give motion to a vehicle, or to a machine. Such motors when driven by an external source of power are capable of generating electric currents; and the momentum of the armature employed, and the object connected therewith, can be utilised for generating more or less powerful currents of electricity, in exact proportion to the energy stored up. As soon as the circuit from whence the energy is derived is interrupted, and whilst the apparatus moves by its momentum, the inventor inserts—automatically or otherwise—a conductor between the terminals of the electromotor. The current thus produced by the motion of the armature will be absorbed by the said conductor, and the motor will be speedily brought to rest; the momentum, or the work stored up or accumulated is thus rapidly absorbed.

15597. "Improvements in contact and reversing gear for dynamo-electric, magneto-electric, and electro-dynamic machines." E. J. HOUGHTON and T. M. COLLET. Dated November 26. 6d. A vessel containing mercury or other conducting fluid has at each end a vertical tube of insulating material, and contains a screw blade, the axis of which is driven by a belt from the revolving armature spindle of the electrical machine, so that, according as the screw blade is driven in one direction or the other, the mercury is caused to rise in the one or the other tube, and, when the armature spindle attains the required speed, to make electrical contact with an adjustable contact screw at the upper end of the tube, whereby in either case, the shunt or field circuit of the electrical machine is closed. The revolving armature of the machine carries a magnet, which, when excited by the said closing of the shunt circuit, attracts an armature fixed on a lever, which, in being thereby moved on its fulcrum, causes the one or other set of commutator brushes to be brought into contact so as to close the accumulator and lamp circuit. For this purpose, the lever carries a small spindle running parallel with it, one end of which carries a cross bar round which passes a strap that also passes round the armature spindle. The other end of the small spindle is connected to an upright rod having a screwed sleeve at its upper end, a loop on which embraces a curved bar carried by opposite curved arms on the one rocking frame of the commutator brushes. The before mentioned strap passing round the cross bar at the other end of the lever, is so arranged that when the armature spindle begins to rotate it moves the strap so as to cant the cross bar, and, consequently, to partially rotate the small spindle in one direction or the other, thereby also bringing the loop of the up-

right rod to the one or the other extreme position on the arms of the brush frame, so that on the subsequent movement of the lever, consequent on the attraction of its armature, as before described, the said rod cants the brush frame in one direction, or the other on its pivot, thereby bringing the one or other of the brushes in contact, and this brush frame, being connected with the other one in any suitable manner, will cause a corresponding motion of the latter. When the speed of the electrical machine is reduced to a certain extent, the mercury will fall in the before-mentioned tubes so as to break contact with the contact screw, and will thus instantaneously cause the field or shunt circuit to be broken. The lever that actuates the commutator brushes being now released by the magnet of the revolving armature, drops, and thus causes the brushes to move back into their middle position, so as to break the charging circuit, and thus prevent the reversal of the current.

1885.

4124. "Improved electrical igniter for ordnance." C. D. ABEL. (Communicated from abroad by J. Jenc, of Pola.) Dated January 19. 4d. The outer brass casing, D, of this igniter, which is cylindrical and which has a hole through its hollowed end, has inserted into it a brass or copper capsule, E¹, fitting accurately into the casing and constituting the electrode capsule, which contains the electrode head, J, provided with a paper covering and pressed firmly into it. For the purpose of firmly securing the insulating paper covering on the latter, it is provided with a circular groove which has, at the same time, the purpose of securing the head in position by means of a bulge, H, in the capsule fitting into it. In addition, the electrode head is secured by means of its groove to the conducting wire, K, passing through the hole of the casing, and which is also insulated by means of a paper cover. The extension, M, of the conducting wire consists of a brass wire covered

with India rubber, the connection being made by overlapping the two ends of the wire, soldering them together, and, after winding fine copper wire round the same, it is insulated by means of a paper covering. To the front of the electrode head, accurately in the centre thereof, the one end of a very fine platinum wire is soldered; the other end of this wire being connected in a similar manner to the inner face of the electrode capsule. The space, Z, in front of the electrode head is filled with a firing composition consisting of equal parts of chlorate of potash and sulphide of antimony, loosely filled in and enclosed in front by means of a paper disc free from acid. Lastly, the space, P, of the igniter casing is filled with a firing composition consisting of fine, somewhat pulverised, gunpowder, which is enclosed by means of a cardboard disc, and above this a metal cap.

4273. "Improvements in method and apparatus for telegraphy." J. C. LUDWIG. Dated April 7. 6d. Relates to a method and apparatus for producing and transmitting electric currents for telegraphic purposes, its object being to provide strong and highly efficient currents for this purpose, while obviating the maintenance of large and continuously expensive voltaic batteries or ponderous power driven mechanical generators. The currents are produced by magnetic induction.

4287. "Improvements in autographic or copying telegraph instruments and circuits." A. M. CLARK. (Communicated from abroad by S. P. Denison, of New York.) Dated April 7. 6d. Relates to a new principle and arrangement of mechanical forms and details applied to the construction and use of autograph or fac simile telegraph instruments and circuits, which by using a current into which constant changes of polarity are introduced, writings or characters are duplicated at a distant point without the need of the presence of any person at the receiving end, and in which the instruments are run or actuated by electricity alone without the use of clock work, springs, or weights.

4717. "Method of and apparatus for commutating circuits for charging successive sections of secondary voltaic batteries." H. P. HOLT and A. E. JONES. Dated April 16. 4d. It is often advantageous to employ, for the purpose of charging a secondary voltaic battery, a dynamo-electric machine of moderate power acting for a long time, instead of a machine of large power acting for a shorter time. The invention relates to means of effecting this in a continuous and automatic manner by the following arrangement:—The inventors divide the battery into a number of sections, each consisting of a group of cells such as can without difficulty be charged by a dynamo machine of moderate power. To the shaft of the dynamo machine they connect by a band or other suitable gearing a commutating apparatus, which after a certain number of revolutions of the machine rapidly breaks its electrical connection with one section of the battery, and brings the next section into circuit with the machine. After the determined number of revolutions of the machine have again been made, the second section of the battery is in its turn cut out of circuit and the next section is shunted in. Thus the machine goes on charging section after section, each section that has been charged, or a group of the charged sections, being available for giving off current, while another of the sections is being charged.

CORRESPONDENCE.

Reis's Telephones.

In your issue of to-day you reproduce an extremely interesting article from the *Scientific American*, in which the following passage occurs respecting the early instruments described in 1861 by Reis, and in 1876 by Bell:—

"In both instruments is latent the capacity for transmitting speech, but by neither Bell nor Reis was this power distinctly claimed. . . . Both inventors appear on the field with devices adapted for the same end, but neither with perfect distinctness claims this function as a part of the invention."

Permit me to point out that these assertions are not justified, so far as Reis is concerned, by the facts. He most unmistakably stated that his instrument was *intended to transmit speech*. The transmission of music by it was merely an after-thought.

The very first sentence of the very first paper written by Reis on the telephone, in 1861, is as follows:—

"The surprising results in the domain of telegraphy, have often already suggested the question whether it may not also be possible to communicate the very tones *of speech* (die Tonsprache selbst) to a distance." There is no ambiguity here as to the intention. Then he states his first prime difficulty. "How could a single instrument reproduce at once the total actions of all the organs operated *in human speech?*" His solution of that cardinal problem was the construction of his first transmitter in the form of a model of the human ear, having at the back of the tympanum a metal microphone with spring contacts to imitate the human ear-bones. He then said, after describing the apparatus, "I give to my instrument the name '*Telephon*.' . . . Until now it has not been possible to reproduce *the tones of human speech* with a distinctness to satisfy everybody. *The consonants* are for the most part tolerably distinctly reproduced, but *the vowels* not yet in an equal degree." These sentences are quoted from the paper contributed by Reis in December, 1861, to the annual report (Jahresbericht) of the Physical Society of Frankfort-on-the-Main, of which Reis, Faraday, Brewster and Wheatstone were members. They establish beyond all cavil the following points:—

1. Reis intended to transmit "the very tones of human speech."

2. The "tones of human speech" included "consonants" and "vowels," in other words, what some people prefer to call articulate speech as distinguished from mere musical sounds.

3. The apparatus was more successful with consonants than with vowels, and though its articulation did not satisfy *everybody*, it is clear that it satisfied some. (This is not surprising, since the vowels are the least important part of speech, and may be altered without affecting intelligibility, as is the case in the differences between different dialects.)

All this was in 1861. In 1863 Reis published printed directions for using the improved instruments, and in these directions told the person listening to the receiver how to signal instructions to the speaker at the transmitting end: "One beat = sing; two beats = speak." These instructions were circulated in Germany, France, and England from 1863 to 1867.

I cannot understand how, in the face of these things, it is that even those who are desirous to giving Reis his just due so often fail in their endeavour. Nothing could be more appreciative, more fair, than the intentions of the writer of the article in the *Scientific American*. Yet he says Reis never claimed "this function (*i.e.* transmitting speech) as a part of his invention. *Never claimed this function!* Why that was the starting point of the invention; its pith; its marrow. That was the dream which for nine years had wrought in his brain before he had made a single experiment. That was the essence of the invention which he brought to the birth, and gave freely and without

reservation to the scientific and commercial world, the invention which he lived for, and wrapped himself up in, until his all-too-early death. I say nothing here of the abundant evidence of contemporary documents and contemporary witnesses. I leave Reis's own written and published words to speak for themselves. *Litera scripta manet.* Not even the ability of the smartest Yankee lawyer can destroy the evidence to be found on the shelves of every great European library. Mr. Dickerson will find that out some day—perhaps when all the world (except himself) has ceased to ignore the very stubborn fact that Philipp Reis did actually write these unmistakable sentences in 1861, about his invention for transmitting speech.

I have spoken of Reis and what he described as his invention in 1861 and 1863. Let me extract from Bell's specification (U.S.) of 1876 the passages which relate—as we are now told—to the transmission of speech.

"There are many other uses to which these instruments may be put, such as . . . the telegraphic transmission of noises or sounds of any kind."

"One of the ways in which the armature may be set in vibration has been stated to be by wind. Another mode is . . . by the human voice or by means of a musical instrument."

"I claim" . . . "The method of and apparatus for transmitting vocal or other sounds telegraphically."

The language of Bell's specification is more general than that of Reis, but it is at the same time far less significant or descriptive. Plenty of matter about "musical notes," and "dot and dash," and "signals" of Morse code, and "pitch," and "amplitude," and "multiple telegraphy," but never a word about "speech," or "consonants," or "vowels," no instructions how to signal to your friend when to "speak." No; the nearest approach to anything of that sort is—"noises or sounds of any kind," "vocal or other sounds." But, weak though this may be, the use of such general and feeble terms does not prove that Bell did not contemplate at that time the possible application of his "*new and useful improvements in telegraphy*," to the transmission of speech. It merely proves that Bell, on the 14th of February, 1876, was still far behind the point attained by Reis on the 1st of December, 1861. He was only fourteen years three months and thirteen days too late; and even then not abreast of that which Reis had accomplished without either attorneys or capitalists to back up his efforts.

Silvanus P. Thompson.

September 5th, 1885.

The Brooks Underground Cable System.

I notice in your number of August 15th, 1885, a letter from G. A. Hamilton, dated July 29th, 1885, in which he gives statements from "S. S. Bogart per B. W." concerning failure in January, 1883, of the Newark-Jersey City Cable, contradictory to the statement of S. S. Bogart pure and simple, made in the month of May following (May 24th). As the statements of "S. S. Bogart per B. W." are contradicted by S. S. Bogart pure and simple, who are we to believe? I prefer the statement of S. S. Bogart pure and simple, inasmuch as it was subsequent, and by S. S. Bogart himself. We know they experimented on those conductors with the currents from six dynamos connected up in such manner as to give the greatest potential, and by that means could spark through (in a portion of the cable not laid by Mr. Brooks, and containing no oil) from conductor to conductor, or from conductor to pipe, but when tested afterwards with a battery of a hundred cells the insulation would be clear. S. S. Bogart pure and simple did not consider that sparking phenomenon a failure of the conductors.

Successful working underground is never mentioned by Mr. Hamilton for "the purpose of killing underground bills," otherwise he could have referred to the Western Union wires working under ground through our conduit in this city for over two years without interruption. I trust he will refer to this the next time, and also treat upon their experiments upon those wires with their dynamos which had no effect upon the insulation, but set their Philadelphia office on fire, causing a loss of $25,000 in the destruction of instruments and fixtures. We know they pretend it was somebody else's dynamo, but I have very good proof that it was their own, Be kind enough to keep Mr. Hamilton's attention directly on this under ground business and away from the Hebrew bootmaker and oblige me.

H. C. Frempt.

Philadelphia, *August 25th*, 1885.

Lighting at Ashton Court.

With reference to the note in your last issue under this heading, will you permit us to say that we supplied our Patent Ozokerited India Rubber Cables to Sir Greville Smyth for this installation. We are not informed whether cables were also purchased from other makers, but the sizes we supplied were 7/16, 10, 12 and 19 B.W.G.

W. T. Henley's Telegraph Works Co., Ld.
G. SUTTON, *Secretary.*

London, E.C., *7th September*, 1885.

[In reference to this letter, and to show that editing is, after all, but a simple matter, we beg to submit to our readers generally and to our correspondent in particular, the following communication, asking only in return that if any other firms supplied cable for Ashton Court they will intimate the fact to us at an early date in order that we may make one notification serve for all.—EDS. ELEC. REV.]

In noticing the installation at Sir Greville Smyth's at Ashton Court, you were particular to mention a variety of details, including the belting used, but your informant seemed to have entirely overlooked the important element of cables, which we observe is very often done; will you kindly put amongst your "Notes" an appropriate note that "the cables and wire" were all supplied by us, and oblige

Walter T. Glover & Co.

September 2nd, 1885.

Irish's Telephone.

I read in your issue of August 22nd a paper on Irish's new telephone. I invented an instrument quite similar to his own in September, 1884, and constructed this instrument in March, 1885, conjointly with Mr. Chienpont. The trials (the telephone being used as receiver) were very successful. We kept up during these trials a voluminous correspondence, which is, we think, a sufficient proof of our priority, although Mr. Irish had patented his instrument before March, 1885.

If Mr. Irish would like to have further details I shall be glad to furnish them to him.

W. Dierman.

Ghent, *September 7th*, 1885.

Electric Bell Indicators.

We notice in last week's issue of your paper a description of an electric bell indicator, which you stated as being manufactured by Mr. E. Thurkle. Will you allow us to say that we have been making an indicator upon the same principle, but in an improved form, for some months past, and have since we introduced it found it to give every satisfaction; so much so, that we have made special arrangements for its manufacture on a large scale.

King, Mendham & Co.

Bristol *September 7th*, 1885.